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THE INDIAN OCEAN.

Being Results largely based on the Work of the Percy Sladen Expedition in H.M.S. "Sealark," Comm. B. T. Somerville, 1905.*

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Perchance of no area of our great oceans do we at the present day know less than of the Indian ocean within the tropics. Fifty years ago, in the days of the great China and Indian clippers, it was, save for a small area to the north of Madagascar, alive with white wings, anxious to take advantage of every slant of wind or the smallest current. Its minutest characteristics were then the subject of anxious study, whereas now its greater part is to most navigators an unknown sea. With the opening of the Suez canal there was a profound alteration of trade, and the most important routes now start, not from Mauritius or the Cape, but from the Red sea. Hundreds of steamers, laughing at winds and currents, pass annually from Aden to Bombay and Colombo on the one hand, and to East African ports, to Madagascar, Mauritius, and Seychelles on the other. From Colombo, again, there are regular lines to Calcutta, Singapore, West Australia, Mauritius, and South Africa. But, except on the lines from the Red sea to Colombo, and from the latter to the Far East and to Australia, there is a relative absence of competition, a want of that necessity for accurate knowledge of the winds, currents, and topography, which is only called forth by a keen desire for saving time or mileage. The routes across her surface are also wide apart, and her islands are commercially unimportant. Great areas are seldom or never crossed by ships; in our six months' cruise on H.M.S. *Sealark* we never saw,

* Read at the Royal Geographical Society, June 11, 1906. Map, p. 424.

except in port, a single steamer, and only one solitary brig, a small trader from Mauritius to the Chagos.

Scientific expeditions, for the most part, avoided the Indian ocean. Closed in by land to the north, to the east, and to the west, their leaders deemed her problems of lesser importance than those of the Pacific and Atlantic. The possibility of such extensive movements of water as in the greater oceans was not to be considered. The biological conditions of her shores were deemed to present little variation, and her islets to be mainly coralline, mainly oceanic, and *therefore* all the same. Yet it was these same conditions which appealed to us in arranging our route. We felt that the day of vast expeditions, ranging through two or three oceans, was passed. Knowing some of the problems to be solved, we decided to attack them in a restricted area, as free as possible from the complications brought in by wide ranges and variations in temperature, currents, winds, and indeed all physical conditions.

The distribution of marine animals and plants was a main feature in our work, since from the geographical side no real investigation has as yet been attempted. Many organisms are purely littoral, and many are restricted in depth. Many, again, are adapted only to peculiar conditions, to particular environments. Yet we must consider how far the arrangement of marine animals and plants over the globe has been occasioned by the past changes of land and sea, and, conversely, how far it elucidates such changes (as undoubtedly does the present distribution of land organisms). For this purpose marine littoral life, restricted in its bathymetrical range, promises the best results. We have to know, in the first instance, what forms occur in each locality we are considering, and in what environment each can dwell, temperature, range of depth, nature of bottom, etc.; then we inquire how far each can be distributed by its larvæ, eggs, or spores, or how long such larvæ, eggs, or spores can continue to exist as such in the open ocean. Experimentally, we cannot simulate the conditions of the ocean, nor can we estimate satisfactorily accidental means of dispersal, such as by floating timber or weed. Indeed, to obtain accurate knowledge under this head, we have to find islands separated by deep sea and with no suspicion of ancient land within the bathymetrical limits of their organisms, and then to compare extensive collections from such with similar collections from neighbouring continental lands. As the smaller islands of the Indian ocean (with the possible exception of the Seychelles) seemed in this sense to be purely oceanic, their littoral organisms appeared to be particularly suitable for comparison with those of the surrounding continents, of which many accurate lists have been made. We may in this connection refer to the work by naturalists of all countries, particularly German, on the fauna of East Africa and the Red sea; to the fauna of South Africa, now being undertaken by the Cape Colony; to the work of the R.I.M.S. *Investigator* under Colonel

Alcock around India; to the Ceylon Oyster Reports by Prof. Herdman; to the Maldive expedition of Prof. Agassiz, and to an elaborate report on the fauna and geography of the Maldive and Laccadive archipelagoes by the author, as the result of 14 months' collecting in those groups; to much work in Malaysia and off West Australia, the results of most of which will be (or have been) incorporated in the report of the Dutch *Siboga* Expedition. How far the present expedition will throw valuable light on this question of the distribution of littoral animals and plants it is impossible to say to-night, or, indeed, until the collections are worked out. Our results so far are promising, as we found great diversity of life in similar environments in different

TAKAMAKA ISLAND, SALOMON ATOLL, CHAGOS. SANDY LAGOON BEACH WITH TIDE PARTY.

localities, and a progressive increase in variety of forms as we approached continental land. In any case, the question appeared to us to be one worthy of most careful attention, and, as marine organisms are subject to less variations in conditions than land forms, to be one likely to yield important information in respect to the changes of land and sea in past geological periods.

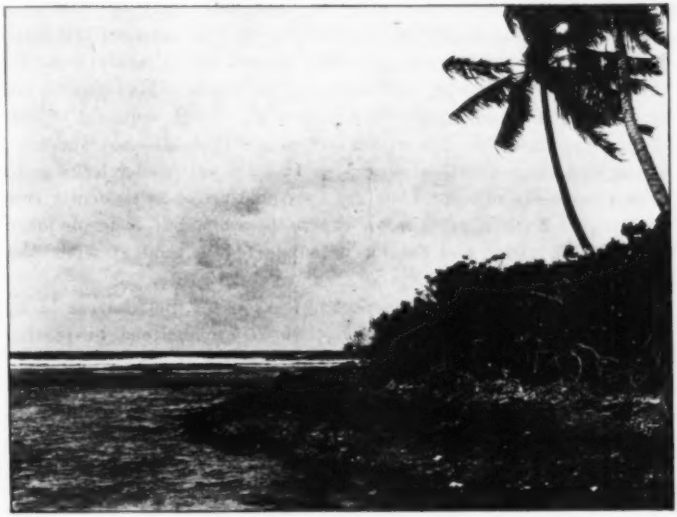
In any question of the oceanic nature of any island or reef, it is obviously necessary for us to know accurately (1) the topography of the ocean in which it is situated; and (2) its possible and probable geographical changes, particularly the relations of land and sea to one another in the past. Our knowledge of the first of these in the Indian ocean was meagre in the extreme, certain most important belts, where

ridges might naturally be supposed to exist, having been left unexplored. The *Challenger* Expedition passed to the south of the Indian ocean properly so-called. The English Admiralty has always run lines of soundings where its surveying vessels have been sailing, but India belongs to a different survey, and the lines necessarily are few, a single line from the Seychelles towards North Sumatra and certain sections run by the telegraphic companies from Africa to the Seychelles and Mauritius, and from the latter continued further to Cocos-Keeling island and Australia. The *Valdivia* Expedition made a rapid traverse along a route which ran from Kerguelen to Cocos-Keeling, Sumatra, Nicobar, Ceylon, South Maldives, Chagos, Seychelles, and Zanzibar. The author contributed a few soundings between the banks of the Maldives, while Prof. Agassiz was responsible for a more extended series in the same region and a section to the south of Addu.

The few soundings of the *Valdivia* in the west half of the Indian ocean were of primary importance, but a gap was left in the middle between the Maldive and Chagos groups, and no soundings were attempted between the banks of the latter. Her course from the Chagos was more or less north-west to lat. 2° 39′ S., and then straight to the Seychelles. Two soundings of 1499 fathoms, lat. 2° 57′ S., long. 67° 59′ E., and 1891 fathoms, lat. 2° 39′ S., long. 65° 59′ E., gave indications of a shallower bank, which might, or might not, connect with the Maldives, Chagos, or the Seychelles-Mauritius line. For the rest, the contour map published by the *Valdivia* follows between the islands of the West Indian ocean in a more detailed manner the one published by the author in connection with a previous expedition, and was based on the same evidence. While the presence of ridges or shoaler grounds between continents or islands cannot be taken as evidence of former connections or separations, yet they may give indications of such. The discovery of the *Valdivia* was accordingly of great interest, and it naturally suggested that there might be broad or narrow ridges of lesser depth even from Madagascar to India.

The land connection of South Africa and Madagascar with India can scarcely be disputed, though its duration and the changes which have taken place in it may legitimately be discussed. Parts of each continent would appear to have remained continuously as land from the Carboniferous to the present day, while the present land connection between India and South Africa through Persia and Arabia cannot have come into existence before the Middle Tertiary period. Remains of the same land fauna and flora from the Carboniferous to the Middle Secondary period are found in both South Africa and India, and must certainly be deemed to prove a land connection, which can only have extended along the Madagascar-Ceylon line. North-west and south-east of this bridge were marine faunas quite distinct yet recognizably of the same geological periods.

In the Upper Secondary (in the Middle and Upper Cretaceous), and even in the Lower Tertiary (Eocene), there was sea covering the southern part of Europe and parts of North Africa and Arabia, connecting the Atlantic ocean with the Arabian sea. On either side of the line of connection between Madagascar and India, we find still distinct marine faunas in elevated submarine deposits of the Upper Cretaceous period. This fact implies that there was no connection of the oceans until the Eocene at least, such as would have enabled the faunas of the two oceans to have seriously intermingled; in other words, that the connection between Madagascar and India continued up



JACOBIN ISLAND, SALOMON ATOLL, CHAGOS. CORAL ROCK OF SEAWARD END, WITH REEF OFF SAME.

to the Eocene, though with possibly one or two straits not sufficiently broad for the intermingling of the two marine faunas, though serving to separate the land organisms of the two regions. Africa would at this time have been an island, and it probably continued to be so until the middle or commencement of the Upper Tertiary, during which it had a wide land connection across the Red sea through Arabia to South Europe, to Asia, and so to North America and to India.

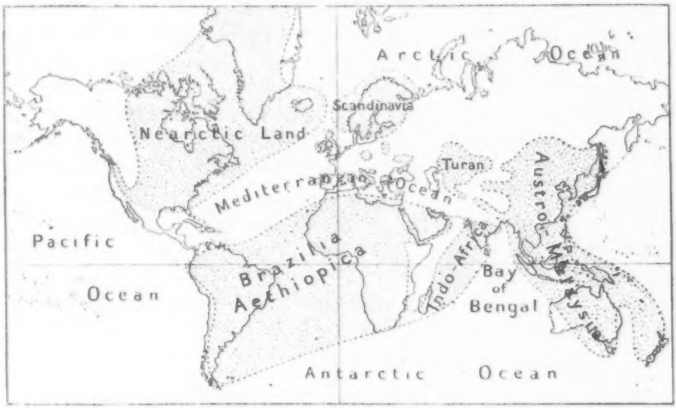
If the above be a true history—and it seems to us that all related facts with regard to the present distribution of land animals are capable of satisfactory explanation by its means—we might reasonably expect to find at the present day some traces of that great, elongated, connecting isthmus, or chain of islands, of the Eocene. In the first

instance, we should be disposed to look to a subsidence to explain its destruction. On this view we might reasonably hope to find some remains of its ancient mountains still existing. With the possible exception of the Seychelles, which, it will be shown later, separated (if a connection ever existed) at an earlier date, we find no trace of such. All islands that exist are of coral formation, and are separated from one another by wide tracts of sea. If they be assumed, for the moment, to owe their existence to a slow, long-continued subsidence—a supposition which, when we examine their present topography, we can scarcely allow—it is difficult to understand their rather scanty distribution and wide separation from one another. On this view, at the commencement of the subsidence, there would have to have been relatively low belts of land between the Maldives and the Chagos, and between the latter and the Seychelles (if the connection did not run directly from the Seychelles to the Maldives), and again to the north of Madagascar, and between the individual reefs which now exist. Next, we must suppose that for some reason the life which forms coral reefs did not and could not exist at first around their shores, so that the subsidence left a series of isolated mounds of approximately the same areas as the coral reefs now occupy. Such a view is, of course, possible, but it is obviously beset with difficulties, and cannot be supported by analogy with other regions.

The difficulties, indeed, in respect to the present distribution of the coral reefs would appear to be such that we are inclined to question the possibility of subsidence being the main cause of the disappearance of our former isthmus or chain of closely connected islands. On any view the area to the north of the Seychelles, that is, the Arabian sea, has been covered by water since the Lower Secondary Period (Trias), and was for part of this time in free communication with the Atlantic by a much enlarged Mediterranean. That great sea between South Africa and Australia, up into the Bay of Bengal, has also, in all probability, existed since the same period. It can scarcely be supposed that the subsidence was purely local along the ridge dividing these two seas, the line not being one of weakness, or of any volcanic activity, so far as we know, and on neither side of it is any trace now to be found of any such subsidence. Again, we find elevations of late Secondary and Eocene rocks on the coast of Madagascar, South Africa, and India, as well as rocks of still later periods. This fact, together with the existence of deep water (2000 fathoms) round the north and east of Madagascar and round South India without any marked tailing off of the land-slope to its depth, points to the subsidence having necessarily been local, and having ceased to operate peculiarly abruptly at either end.

Granting, then, our premises of the land connection up to the early Eocene between India and Madagascar by a relatively narrow isthmus,

or a chain of large islands with narrow straits between, what is the cause of the disappearance of the then existing land, if it be not due to a subsidence of the sea bottom? As far as we know the facts, as far as we know the marine deposits, we must remember that throughout the Eocene, and part, if not all, of the Miocene, there was continuous sea extending to our ridge from Panama, which not improbably did not exist as an isthmus in the Eocene, when there would have been a free connection with the Pacific. On the other side, again, there was open sea even to South America, both by the south of Australia and New Zealand, and across the Malay archipelago. Indeed, save for our isthmus, and for part of the time that of Panama, there would have



DISTRIBUTION OF LAND AND WATER IN THE JURASSIC PERIOD (AFTER NEUMAYER).

been a practically continuous water-connection around the whole world.

The tides at the present day are admittedly of comparatively small importance, since they are broken up by the three lands of America, Africa, and Malaysia; but with open sea more or less round or near the equator, they must have had extraordinary force. Indeed, with such tides it is doubtful whether any coral island, like to those of the present day, could have existed, while navigation across the equator might have been quite impossible except by a favoured coast-route. Yet, from the analogy of the existing lands, particularly of the East Indies, we can perhaps get, especially when our isthmus gave place to a series of separate land-masses, some clue as to the probable effects of these great tides, sweeping across more than half the world, to be resolved into currents through straits or over ridges.

The *Siboga* Expedition through the East Indies was primarily not an hydrographical expedition, but there were expert surveyors on

board, men who knew the importance of the facts they stated, and who can be implicitly relied upon. Throughout the whole general account of the cruise we find constant references to the strength of the currents, and their effects to various depths even beyond 1000 fathoms, to the bottom being bare and hard, completely current-swept in many straits, to the action of the sea upon the various lands, to the former connection between Bali and Lombok, etc. Considering the facts collected by the *Siboga* and accumulated by geologists and others in respect to the East Indian archipelago, there seems to be a strong case for the separation of the islands, particularly of the line from Sumatra to Timor, or Timor Laut, having been occasioned, not by subsidence, but by marine actions in progress since the Pliocene period. The ultimate result should be analogous to the present condition of the Indo-Madagascar ridge, but, the Malay connection being broader and less open to the full forces of the tides, the effects would not be as great.*

We may also draw attention to the existence of important ridges in the Atlantic lying more or less parallel to the direction of tidal force—a fact surely worthy of consideration in reference to past land connections, and to the fact that ridges crossing this direction are bare and markedly current-swept. "In archipelagoes like the Canary islands, which are separated by channels having often a minimum depth of 1200 fathoms or more, the crests of these ridges are swept bare of sediment, and are hard rock, generally calcareous and manganiferous."† We may also refer to the facts relating to the Maldives, particularly the soundings established by Prof. Alexander Agassiz,

* In this connection see in the *Siboga* Reports, 'Introduction et Description de l'Expedition,' by Max Weber, pp. 14–20, 52–53, 62, 102–105, etc.; and 'Hydrographic Results of the *Siboga* Expedition,' by Commander G. F. Tydeman, "List of the Soundings," particularly pp. 85–86, and "Remarks on Currents," pp. 5–6. The following observation, made with a heavy net let down to the bottom and hauled up vertically through the water in Manipa strait, may be quoted as showing how valuable observations may be made on deep currents, even without the use of regular metres. The ship was drifting 0·5 mile per hour in a northerly direction, and 1536 metres of cable were out, pointing in a southerly direction, and making an angle of 10° with the vertical. "When the net was drawn up, the cable remained in about this position until there were still 800 metres out. From this moment the cable approached more and more the vertical position, and then passed same, so that it pointed under the ship in a northerly direction. When there were still 100 metres out, the position rapidly changed, and the cable went strongly to starboard again, *i.e.* pointing to the south, now making an angle of 25° to 30° with the vertical, until the net arrived at the surface." The deduction from this observation was that the water was at rest below 800 metres, streaming north from 800 to 100 metres, and south from 100 metres to the surface. To explain this, Commander Tydeman supposed that the great depths of Manipa strait must be interrupted by a ridge of smaller depth, of 800 metres. This was partially confirmed the same day by soundings of 1067, 1195, and 940 metres, the lead twice striking hard ground, apparently subject to strong scouring by the current.

† "A Retrospect of Oceanography," by J. Y. Buchanan, 'Report of the Sixth International Geographical Congress,' 1895, p. 25.

and to our own observations and views on the same locality, in which we considered in detail the possible formation of that whole group of atolls by the cutting up of a continuous land mass—perhaps by agencies still in progress—into separate plateaus, upon which coral reefs were subsequently built up.* Lastly, we have evidence collected by the present expedition relating to the existence and effects of deep-sea currents along the line under consideration. Some of this will be given later when the geographical characters of the banks and islands visited are discussed.

To summarize our view, we consider that up to the end of the

ANGLAISE ISLAND, SALOMON ATOLL, CHAGOS. A DRIED-UP POOL IN CENTRE OF ISLAND (AN OLD REEF-FLAT) FRINGED WITH SEAEVOLA.

Primary period India and South Africa were connected to each other by a broad belt of land, which included the areas at present covered by Madagascar and Ceylon. In the Secondary period this land-connection

* "The Coral Reefs of the Maldives," by Alexander Agassiz, *Mem. Mus. Comp. Zool.*, Harvard, vol. 29, 1903; and "The Fauna and Geography of the Maldive and Laccadive Archipelagoes," by J. Stanley Gardiner, pp. 12-50, 146-183, 313-346, 376-423: 1902-3. It is not to be inferred that Prof. Agassiz agrees with us in our conclusions from these facts. His results in the Fiji islands, with which we largely agree, well exemplify the important part played by marine erosion on islands with broad tracts of ocean on either side, not restricted by any masses of continental land, "the submarine platforms upon which the barrier reefs have grown being merely the flats left by the denudation and erosion of the central island, while the atolls are similar flats from the surface of which the islands have at first disappeared, and the interior parts of which have next been removed. . . ." ("The Islands and Coral Reefs of Fiji," *Bull. Mus. Comp. Zool*, Harvard, vol. 33, p. 135: 1899.)

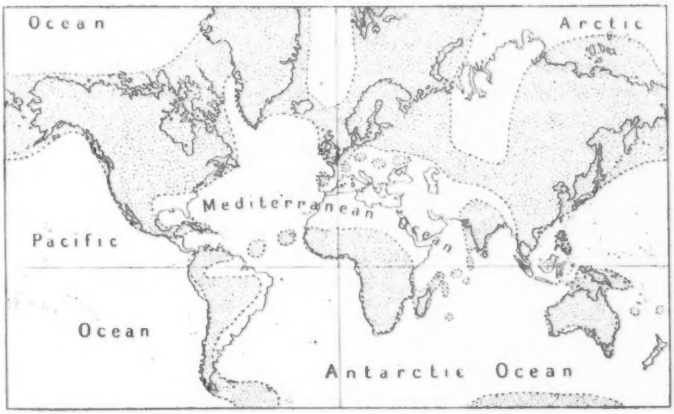
continued unbroken; but towards the end of that period, in the Cretaceous, its breadth was restricted, partially by marine action, but largely by subsidence, of which we find the remains at either end in submarine deposits of the same age subsequently upheaved. At about the commencement of the Eocene the first straits were formed, probably between the present Saya de Malha, Chagos, and Maldive banks. They were probably not of sufficient importance to cause an intermingling of the marine faunas of the east and west coasts of India and Madagascar during the lower half of the Eocene, though they would have profoundly affected the distribution of land animals. At this time there would have been continuous sea around the globe, narrowest at our straits, and we would ascribe the present conditions along our belt entirely to subsequent marine action, independent of upheaval or depression—to action which had its chief force in the Eocene and Miocene, before the ocean was cut by a land upheaval joining Asia and Africa, but which is still to some degree in force. The commencement of the formation of atoll-reefs along the belt we believe to have been due to the change of conditions brought about by this last separation, and perhaps that which formed the Sumatra-Timor land. At the present day, since the action to some degree decreases from south to north, we should find greater perfection of atoll-formation in the same direction, a series perchance of coral banks showing stages in formation, and this to some degree we believe to be the case.

The coral reefs of the west half of the Indian ocean may for our consideration be divided into four sections: (*a*) Maldive, (*b*) Chagos, (*c*) Seychelles, and (*d*) Farquhar. To (*a*) belong the Maldive and Laccadive archipelagoes, containing a large number of reefs, all with land, some of them exhibiting the atoll-ring in its typical form. The *Scalark* Expedition did not further investigate them, and we may here refer simply to the accounts published by Prof. Agassiz and ourselves (*loc. cit.*).

In (*b*) we have merely the reefs and banks of the Chagos archipelago, separated from the Maldives to the north by about 2000 fathoms of water. They comprise Diego Garcia, with a circumference of 35 miles, over 30 of which is crowned with continuous land, one large and two narrow passages to the north separated by islets; Egmont, six islands on a narrow atoll, 13 fathoms deep, $5\frac{1}{2}$ miles long by $2\frac{1}{2}$ broad, with a long opening to the north; Salomon, the centre of our work, an atoll with one passage to the north, a little longer and broader than the last, with eleven islands and a depth of 17 fathoms; Peros Banhos, a large square-shaped bank, 41 fathoms deep, comprising about 160 square miles of surface, its rim 50 miles long, of which only 34 is covered by surface reefs, quite open to the south-east except for two patches of reef, in all thirty-four islets and thirteen passages; Blenheim reef, a similar atoll to Salomon, but without land, 10 fathoms

deep, widely open to the south; Great Chagos, an enormous bank of nearly 4000 square miles, with a depth of 45 to 50 fathoms, and a rim at 5 to 10 fathoms, with only seven patches of surface reef, each with land; Victory, a small atoll bank, with rim at 3 fathoms; Speaker and Pitt, large banks with about 24 fathoms in their centres, and rims completely covered by 5 to 10 fathoms; and, lastly, a number of small submerged patches and banks, some apparently quite flat, but not sufficiently delimited for our purposes.

The area comprised by the Chagos extends 180 miles north and south, and 120 miles east and west, in all about 21,000 square miles. Its banks, as enumerated above, give a series from almost completely enclosed atolls to shoals completely submerged and scarcely hollowed



DISTRIBUTION OF LAND AND WATER IN THE LOWER EOCENE PERIOD.

out. Individually the reefs present the same general characters as those of the Maldives. They differ, however, in detail in that their outgrowing edges are, *practically entirely*, formed of nullipores, though corals are important builders from 5 to 30 fathoms. If their fauna be compared with that of the Maldives, it is noticeably scanty in species, though the bulk of animal life is as great—a fact which leads one to hope for interesting results in the distribution of marine animals in the Indian ocean. Lastly, we found throughout the group evidence of the land having very largely been formed by some small change of level of the reefs in respect to the water in past ages, similar to what we before found in the Maldives and Minikoi.

The whole Chagos archipelago lies on a bank at about 700 fathoms, and is bounded on all sides by over 2000 fathoms of water. The depth between the different banks varies from about 350 to 800 fathoms,* to

* We are, unfortunately, unable to give a chart showing the soundings, or more accurate information, as the revised chart has not yet been submitted to the Admiralty.

which all slope in the regular manner of isolated coral reefs, gradually to 30–50 fathoms in 200–600 yards, followed by a steep to 120–200 fathoms, and a more gentle slope to the general bottom-level in the vicinity. The contour of any bank, though, may be modified in any position by that of the mound on which the whole bank arises. Thus Salomon atoll, being more or less enclosed in by banks to the north, south, and east, is not nearly so typical in this respect as Diego Garcia or Peros Banhos. The characters of the slope and of the bottom between different banks were the main objects of our investigations within the groups. We ran sections over the steep, and attempted to dredge it. For the former we used all sorts of leads, and found a hard bottom strewn with dead corals and nullipores. Dredging showed that these all belonged to kinds living on the reef above, and that they were held in position by being wedged together and cemented by sponges and other organisms. In fact, it was a talus slope, built of the remains of reef organisms, swept out by under-currents from the reefs above. At the bottom of this steep, the talus was found to continue outwards, the individual fragments getting smaller and smaller for 1 to 2 miles. The bottom then gradually became smoother between the banks, until finally it resembled almost a hard concreted road. The lead generally came up empty, sometimes with a fragment of reef coral, but *never* with any mud or ooze. With a half-inch wire rope we hauled, for several miles between Salomon and Peros, trawls and dredges, with nets and bags, and even once a plankton net. They were never caught up nor torn in any way, and their swords and sides came up polished, proving that they had been sweeping along the bottom. Their contents were practically devoid of animal life, and consisted of a few fragments of dead coral. The latter were all rounded, as if constantly rubbed, and absolutely clean, without a trace of coral mud; in fact, it was quite clear that the bottom between the banks of the Chagos was everywhere current-swept even down to 1000 fathoms. Furthermore, the difficulty experienced, when the ship was drifting, in getting our dredges and trawls, generally of quite sufficient weight, on to the bottom, until we lashed them up with fire-bars, and the way in which the sounding-wire was dragged, showed clearly the existence of strong currents at every depth. With strong winds blowing, the dredging-wire constantly dragged under the ship when drifting, proving the existence of under-currents of greater force than those of the surface. We had not the stronger dredging-wire, with which we might have anchored had the weather been propitious (which it never was), so as to make precise measurements; but we venture to think that no practical surveyor could have had any doubt as to the existence of strong currents between the atolls right down to the bottom during the whole of our stay in the Chagos. On the whole, we are inclined to consider that the present banks of the Chagos were formed in a

similar manner to those of the Maldives, by the cutting down of a land by the action of the seas, and by the subsequent upgrowth of coral reefs, as the currents moderated. Subsidence may have taken a part in perhaps paving the way for this action, but in any case we can have no doubt of the importance of erosion in the past and the present day in shaping the archipelago.

Réunion, Mauritius, and Rodriguez are three isolated, volcanic

islands lying between lats. 19° and 21° 30′ S. They are respectively 10,069, 2711, and 1300 feet in height, and Réunion has a still active volcano—the only one in the Indian ocean—in Grand Brûlé, 8613 feet in height. There is nothing in the topography to indicate any special connection between the three islands, and they are probably to be regarded, together with two small shoals near them, as of quite separate formation both to one another and to the large banks that lie to the north. Their reefs are for the most part fringing, but approach the barrier condition off parts of Mauritius and Rodriguez.

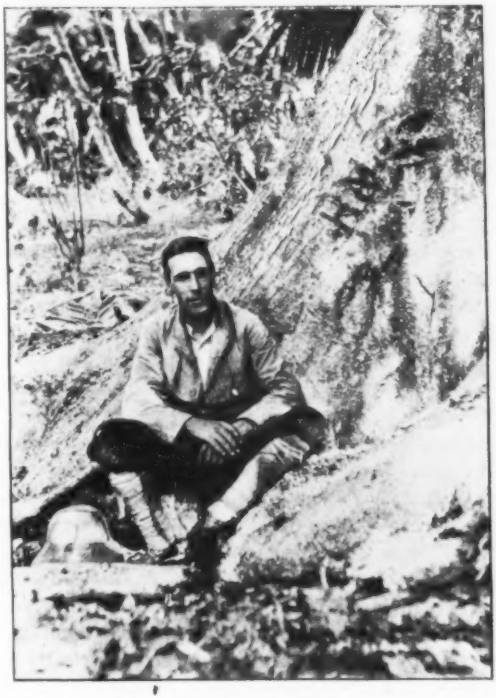
Elevated coralline limestone has long been known to occur in Rodriguez, and in Mauritius we found most of the islets and some of the shore at Grand Port (where alone there is a real barrier reef) formed by an evidently recent elevation of something over 60 feet.

In passing onwards we would draw attention to that deep bight of water which lies to the east of Madagascar, and which is more or less enclosed by our third series of shoals and reefs—that of the Seychelles. We did not attempt to investigate it beyond running a few soundings to the north-east of Madagascar, as it seemed to have been sufficiently sounded. Its average depth is about 2300 fathoms, and soundings between Mauritius and South Africa clearly show it to be quite open to the south, while we found 1962 fathoms between the former and the Nazareth bank. To the north-west again there proved to be over 1800 fathoms between Cape Amber, Madagascar, and Farquhar, and 2170 fathoms between Providence and Alphonse-François. Unfortunately, our sounding-machine broke, so that we could get no depths between Alphonse and the Amirante bank; but there was already one sounding of 952 fathoms marked on the chart, on which also is recorded a depth of 1150 fathoms a little south of the direct line between the latter and the Seychelles bank. Probably both banks are included within the same 1100 or 1200 fathom-line as the Seychelles. To the north-east the wall would appear to be more complete, since we found a maximum depth of only 961 fathoms between the Seychelles and the north Saya de Malha bank, 636 and 130 fathoms between the three Saya de Malha banks, and 222 fathoms between the latter and the Nazareth bank. Considered together, these soundings would point to a remarkably close connection between the Saya de Malha and Nazareth banks and to a relationship between all the banks of the crescent from Alphonse to Cargados.

Providence and Farquhar, between which there is a depth of only 890 fathoms, would belong to a different group, which not improbably extends for 300 miles east and west, so as to include Aldabra, Assumption, Cosmoledo, and Astove. Of this group—our fourth series (*d*)—we visited Farquhar, Providence, and St. Pierre only, not deeming the question of their connection with the others to be of as great importance as the hills marked in the charts of some of the Amirante islands, and the weather being unfavourable. Aldabra, Cosmoledo, Farquhar, and Astove are all atolls, the three former of 19, 9, and 10 miles in length by 6 miles broad, while Astove is $2\frac{1}{2}$ by $1\frac{1}{2}$ miles. In all the outer rim is nearly perfect, such passages as there are being quite inconsiderable, and their lagoons do not exceed 8 fathoms (Farquhar) in depth. The lagoon is practically surrounded by land in Aldabra, except in three places, together not more than a mile in width, while Farquhar has less than a third of its circumference so covered. The lagoons themselves are full of shoals, and have no islets. Of the other

reefs, Assumption is a crescent nearly 4 miles long, with a fringing reef, and Providence is a reef of similar shape, 24 miles long, with sand islets towards its northern and southern ends. St. Pierre lies about 17 miles west of the last, and is separated from it by nearly 1000 fathoms of water; it is merely a small islet, less than a mile in diameter, with, in some places, a narrow fringing reef.

This group of reefs and islands presents some features of consider-



ÎLE DU COIN, PEROS ATOLL, CHAGOS. MR. FORSTER COOPER AT BASE OF LARGE MAPON TREE, ON WHICH CAPTAIN MORESBY'S INITIALS WERE CUT IN 1837.

able interest. Aldabra has long been known as the home of *Testudo elephantina*, and has several rare and peculiar birds. All are regularly fished for both shell and edible turtle, for which they are famous. Aldabra has been investigated by Prof. Voeltzkow, who describes it as having been formed by a deposit of foraminiferal remains (mainly coccoliths and rhabdoliths), which has been elevated 20 to 80 feet above the sea-level.* There is a narrow fringing reef all round, against which

* *Senckenbergischen Naturforschenden Gesellschaft*, bd. xxvi., 1901.

the land presents small often undercut cliffs. Probably this fringing flat owes its existence largely to the abrasion of the land, as in so many of the Fiji islands. In any case, however the land was formed, there can be no suggestion of its ever having been connected with any other. The evidence of elevation in Cosmoledo, Astove, and Assumption is less clear, and the present islets of Providence are certainly due merely to the piling up of sand on the reef by the wind and waves. Farquhar has a series of small hillocks, and along the middle of the south island a ridge which reaches a height of 75 feet above the water-level. The first section, which we prepared with the horizontal scale half the vertical suggested elevation, but the natural section annexed (with the same scale for both), pointed to a sand-dune, piled up from either side, a conclusion amply borne out by the examination of the material of which it is formed. St. Pierre, however, differed in that it is an island of coral rock, with its summit about 50 feet above the sea, but probably twice as high when first upheaved. It is surrounded by cliffs, and such fringing reef as it has was undoubtedly formed by erosion of the land. It is now the home of countless seabirds, with extensive deposits of guano.

We have mentioned the above comparatively unimportant details, because we think they indicate that these islets lie in a district which is by no means stable, by no means at rest, or subject to the same movement all over its area. The whole series of banks now under consideration may be regarded as occupying part of the site of the Indo-Madagascar continent. Yet, allowing this to be the case, we are seriously inclined to doubt whether its different reefs represent any peaks of that land, but are not rather the result of separate volcanic eruptions. Beyond the general evidence above, perhaps scarcely worthy of the term "evidence," we would point to the result of a dredging in 844 fathoms, within 2 miles of the 100-fathom line, off the south-west of Providence reef. In this we obtained, with a large triangular dredge, a few masses of sticky, semi-consolidated mud and about 5 cwt. of stones. This mud consists of practically pure volcanic ash, while the stones are of these kinds: (1) manganese nodules formed round nuclei of ash, (2) consolidated ash, and (3) masses of coral rock from the reef above, coated with manganese. Now, round coral islands the bottom is invariably covered with masses and fragments of coral, or with coral mud, no trace of which occurs mixed up with the above deposit. In the Pacific ocean, at such depths off coral islands there would certainly be a deposit, into which the sounding-tube would be naturally driven for several inches, and we can only conclude that its absence here is due to strong under-currents, perhaps outwards from Providence reef, perhaps merely passing along the same. This view is supported by the fact that many of the rocks themselves came up with their surfaces quite polished, and with hydroids and worm-tubes

attached, both of forms which cannot exist on mud. Further, the manganese of the nodules is 1 to 2 inches in thickness, and for it to have attained this, the individual nodules must have lain freely on the bottom for long periods. Without attempting to go into the question fully, we may express our conviction that here we have part of the mound on which Providence reef was built up exposed by under-currents and that we have the first definite evidence of the nature of the foundation on which a regular and typical existing coral reef has been built up.

We may, perhaps, here refer to the bottom samples obtained during the cruise, in so far as manganese is concerned. Where carbonate of lime rocks alone exist, as off coral reefs, manganese is not found either

POINT MARIANNE, DIEGO GARCIA ATOLL, CHAGOS. SALT WATER SWAMP, A SUCCULENT PLANT FORMING PEAT AND KILLING THE COCONUTS.

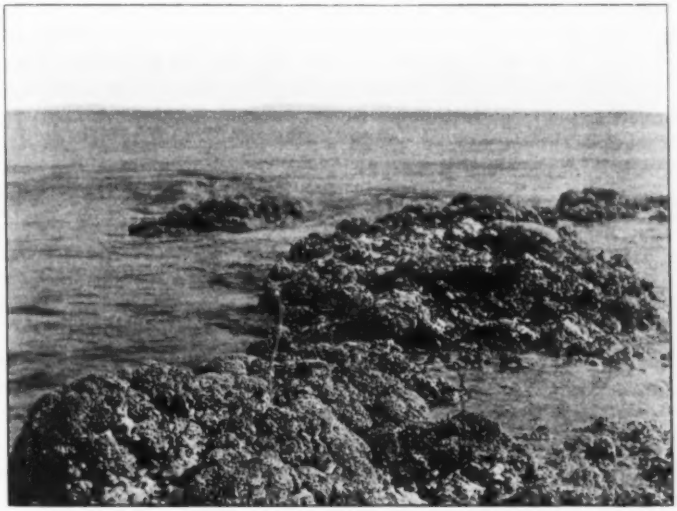
in nodules or as scales in the ooze or mud. Round Ceylon there is plenty, but off Chagos we found no trace, nor yet to the south, until we approached Mauritius, where certain deposits appeared as if dusted with it. Near Farquhar the bottom samples were similar, and at different places off Providence, in addition to the above, we got several coral masses more or less discoloured by it. Again, from Alphonse, through the Seychelles, right down through Saya de Malha to Cargados, we practically found no trace. Such being the case, the presence of deposits containing manganese between Farquhar and Providence, since we can scarcely suppose them to be in any way under the influence of Madagascar, does point to a marked difference in that as compared with other regions we visited.

We pass now to the third series of reefs and shoals—that of the Seychelles, which, in its crescent shape, is particularly remarkable in relation to the former connection of Madagascar and India. Its length is roughly 1300 miles included within the 1100-fathom line, and its probable total dimension is upwards of 100,000 square miles. As already pointed out, there would appear to be a special connection between the Saya de Malha and Nazareth banks, and our investigations showed a close similarity between the same. Nazareth is a bank about 225 miles long by a maximum breadth of about 90 miles, with an extraordinary surface shoal, Cargados Carajoz, at its south end, 32 miles long, crescent-shaped, with its convexity to the east. The main reef has eight islets, and there are in addition over twenty others arising on separate patches of reef within the crescent, besides two isolated islands 3 and 10 miles to the north. Nearly all these islands have (or had) deposits of guano, and were the homes of sea-birds. So far as we could see, they showed little signs of elevation, and their reefs were everywhere typical coral reefs. Unfortunately, we had to confine our investigations to this southern part, the weather being continuously unfavourable, but the rest of the bank would appear to have an average depth of 30 to 40 fathoms, with one area of 14 to 20 fathoms in the centre; in no way did it appear to show any approach to an atoll condition. Opposite Cargados the bank was about 30 miles broad, suddenly falling off, in the four places where we sounded over its edge, from about 40 to 250 fathoms in less than half a mile. Its central part was extraordinarily level, sounding after sounding being recorded between 30 and 35 fathoms. On approaching the edge, there appeared, both to the south and west, to be a decrease to about 27 fathoms, but our soundings alone would scarcely allow us to deduce the existence of any even low rim. However, our dredgings, of which we put down thirty-five, showed a marked line of coral and nullipore rubble around the edge, such as might form the foundation of a surface reef in course of time, while the centre was covered quite uniformly by the hardest of sand, covered with growing weed.

The three banks of Saya de Malha included in their 100-fathom lines are respectively from south to north of about 250, 14,000, and 1200 square miles. The south bank is a flat shoal, and the north one a basin with 40 fathoms in the centre and a nearly complete rim at less then 15 fathoms. The central bank is about 500 miles round by 120 across in any direction. It has a marked rim at less than 20 fathoms for nearly 200 miles to the north-west, and a depth of 50 to 65 fathoms in the centre. To the north of the rim, between the banks, we found the slope to be as precipitous as off Cargados, but to the south the whole bank, according to our soundings and dredgings, appeared to rise up quite gradually from the centre of the channel between it and the Nazareth bank. Our dredgings, indeed, carried us

right on to the bank without any trace of any steep, and disclosed a hard bottom, and within a bight of the 100-fathom line a large area covered with coarse bivalve shells and some coral fragments swept off the reefs above.

The passages below the 100-fathom line between Nazareth and the Seychelles were of interest in respect to the currents, but, unfortunately, we could make no precise observations. The channel between the north and the central Saya de Malha banks proved to attain a maximum depth of about 636 fathoms, bottom hard with a few attached deep-sea corals. While dredging in it from 300 fathoms downwards, the ship



ÎLE DE LA PERSE, SALOMON ATOLL, CHAGOS. NULLIPORE BUTTRESS GROWING OUT FROM THE SEAWARD EDGE OF THE REEF.

drifted 6 miles to the west-north-west in three hours, while we took three hauls of a small trawl. The latter was weighted with firebars, and in each case went down almost perpendicularly for about 150 fathoms, when it began very markedly to haul out to the north-east almost at right angles to the ship's course. Probably our first attempt never reached the bottom, but after adding fresh weights and allowing more wire and as rapid a descent as possible, we succeeded in doing so. Whatever was the cause of the current in an opposite direction to the wind and surface drift we can scarcely profess to say, but of its existence there was no reasonable doubt.

The bottom again between Saya de Malha and the Seychelles would appear to be current-swept, and our impression, when watching the

soundings with the ship's head to the wind, was that there existed a similar undercurrent. Taking all the soundings between 100 and 1000 fathoms in the passages from Nazareth to the Seychelles, we get the following list of bottoms: hard, 10; shell and coral, 6; sand, 8; coral mud, 1. When the actual samples are examined these soundings become of still greater significance, since in no single case was there more than a mere trace of the bottom. Indeed, the bottom throughout in these passages may be said to be hard and with no marked deposits of mud or ooze, such a bottom as could only be found in a current-swept region.

The Amirante bank has eleven patches of surface reefs and seven islets on an area of 1100 to 1200 square miles, about 86 miles long north and south; while Desroches, a round atoll bank 10 miles in diameter, lies about 8 miles to the east, the channel between attaining a depth of 874 fathoms. The bank itself has more or less the same contour as the other submerged banks, probably rising from about 700 fathoms, all round except to the north, to the 50-fathom line. Its surface is decidedly irregular, as masses of growing corals and nullipores may be found anywhere, but nowhere attains a greater depth than 37 fathoms. On its edges, where nullipores flourish, there is perhaps a greater tendency to growth, but the term "atoll" cannot as yet be applied to it. Of its reefs, Remire and St. Joseph are atolls with lagoons of less than 5 fathoms in depth. The former has no land, but there are certain masses on the reef which from the ship appeared to be the remains of such. St. Joseph has eight islands, which clearly demonstrate the increase of its lagoon at the expense of the land, showing everywhere destroyed trees and bushes, and in many places lines of old beaches. The hills marked, doubtless by an error of the draftsman, on St. Joseph and Darros do not exist, but there are indications that these islands, as well as Poivre and Desroches, owe their foundation to some change of level. Eagle island, however, shows a definite upraising of at least 20 feet, being formed of coral rock, and in many places fringed by low cliffs. African islands, lastly, are probably due to a piling up by the sea of reef material.

The Seychelles bank has lying off its south-east part several isolated masses in Fortune, Constant, Platte, and Coetivy banks, the last two only with surface reefs and land. They present no atoll features, nor any conditions markedly differing from the submerged banks which we visited. Coetivy is about 6 miles long, and has sand-dunes and ridges varying up to about 70 feet in height.

(To be continued.)

RECENT SURVEY AND EXPLORATION IN SEISTAN.*

By Colonel Sir HENRY McMAHON, K.C.I.E., C.S.I.

I HAVE said so much on the scientific aspects of Seistan that it may now interest you for a change to learn something of the personal experiences of our mission in that country.

We were a party of nearly 1500 persons, including twelve† British officers, a large staff of European and native subordinates, comprising survey, irrigation, and other civil departments, and a military escort of 200 infantry of the 124th Baluchistan Regiment and 60 sabres of the 35th Sind Horse. We were amply provided with all that was necessary for purposes of display suitable to the status of our mission, or for maintaining our position in the face of opposition or obstruction. We were well equipped for every possible contingency, for heat and cold, flooded rivers and waterless deserts. It is well that we were so equipped, for all our resources had to stand the strain of work under most difficult and varied conditions.

We left Quetta early in January, 1903, and marched across the desert to the Helmand, which a portion of the mission struck at Landi Mahd. Wala, and the rest at Khwaja Ali. A blizzard which the main party encountered before reaching the Helmand, the first of a long course of blizzards with which we were destined to become painfully familiar, burst on us while on the march. We had three men frozen to death, and lost a great number of camels.

We marched down the Helmand, and reached Seistan in the middle of February. We stayed in that country for two and a quarter years. Our life and movements were largely regulated by the climate. Seistan has only two seasons, winter and summer: spring and autumn do not exist. One jumps within a few hours from cold winter into hot summer, and from hot summer into cold winter. The summer lasts from April to November, seven months, and is a long weary period of cloudless sky and great heat, which reaches a maximum in the shade for many months of 110° to 119° Fahr. A portion of the summer, *i.e.* four months, is taken up with that terrible wind the "Bad-i-sad-o-bist roz," which mitigates the heat and prevents it becoming altogether unbearable.

During the early portion of summer the rivers are all in high

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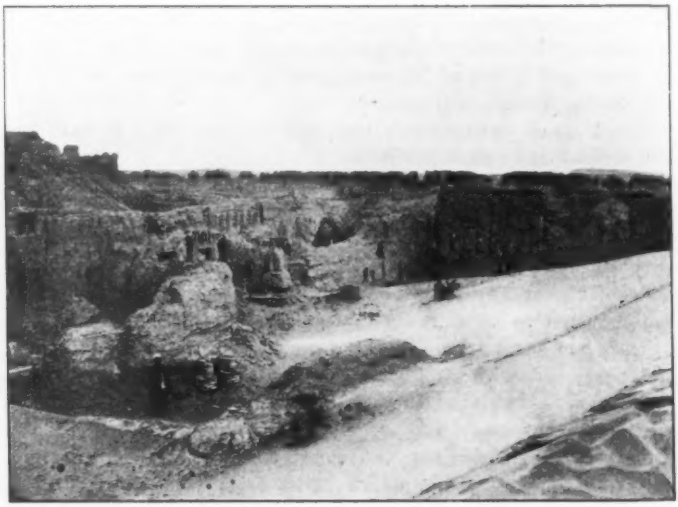
* Continued from p. 228.

† Colonel A. H. McMahon, C.S.I., C.I.E., British Commissioner; Captain A. D. G. Ramsay, personal assistant; Major T. W. Irvine, I.M.S., medical officer; Major H. P. Walters, commanding escort; Major C. Wanliss, intelligence officer; Mr. T. R. J. Ward, irrigation officer; Mr. W. A. Johns, engineer officer; Mr. G. P. Tate, survey officer; Captain R. C. Bell, commanding camel corps; Lieut. C. R. H. P. Landon, with cavalry escort; Lieut. J. A. Brett and A. E. Stewart with infantry escort.

flood, and throughout the summer the Hamun is a big sea, and the lowlying lands of Seistan are either submerged or liable to inundation. We had, therefore, to look round for a place of safety from floods, and we had our main camp each summer on a high, bare, gravel-plain on the south bank of the Rud-i-Seistan and between that river and the Helmand. One of the pleasing features of a Seistan summer is the plague of insect life that swarms in that country. There are no wild flowers in Seistan, and, as I said, no spring season such as one finds in other countries. Nature has, I suppose, to mark the missing season in some way or other, and does so here by the outburst of insects, which come to life the day after winter ends. Midges, mosquitoes, and every kind



PORTION OF INNER LINE OF WALLS OF SAR-O-TAR RUINS, SHOWING ALSO PART OF THE CITADEL.

and sort of flying, creeping, crawling beast imaginable, large and small, fill the air, and cover the ground as evening sets in. To sit near a light is impossible, and so one has to eat one's dinner, insects and all, in semi-darkness, and find one's way to bed in the dark. Another harbinger of what ought to be the spring in Seistan is the exodus from their winter hiding-places of the snakes, which are very numerous in that country. A poisonous little viper (*Echis carinata*) is the most common of them. Four of our men were bitten, but all luckily recovered after some weeks of illness. When the big summer wind sets in, it blows away the insects, and for a time one is free from this plague; but if the wind drops any evening, out they all come again.

Horses, camels, and other animals in Seistan have a plague of their

own in the form of a species of gadfly, which torment them unmercifully all the summer. Their bites draw blood and cause great pain. Worse than this, we have to thank this fly for the prevalence of the disease which proves so fatal to horses and camels in Seistan. This disease we found to be what is known in India as "sarra," and we found in the blood of the gadflies caught on horses the trypanosome of sarra (*Evansii*). To protect our horses from this scourge, we found it necessary to follow the example of the Seistan people, and keep blankets carefully wrapped round our horses' stomachs even when ridden. In the early part of summer, when the scourge is worst, our horses wore pyjamas, and looked somewhat peculiar. Notwithstanding all pre-

VIEW OF INTERIOR OF RUINS KNOWN AS TAHL DAS, NEAR SAR-O-TAR, SEISTAN.

cautions, however, we lost many hundreds of camels from this disease, and out of our 200 horses we lost no less than 120.

So much for the delights of the Seistan summer with its heat, wind, and insects. The winter offered an extraordinary contrast in the matter of temperature, for the cold was often intense, going down to within a few degrees of zero, and this was made all the harder to bear by the terrible blizzards which are so common from December to the end of March. We felt the cold all the more severely, as our work used to keep the whole mission moving about all the winters in the lowlying portions of the country along the banks of the rivers and shores of the Hamun, where our camp was nearly always pitched on damp ground. Our work made us spend the winters splashing about in rivers and

Hamuns, an extremely cold operation when blizzards were on. Necessity is the mother of invention, and our camp soon became very clever in protecting themselves by ingenious methods from the cold and wind. When reeds and branches of tamarisk were available, as they often were, thick screens used to be run up on the windward side of tents and animals, and it would sometimes have been difficult for a stranger to find our camps, so well were they thus sheltered.

To give some idea of the extent of the cold and the force of the blizzards, I may note that in January, 1905, not only the stagnant Hamuns and lakes were hard frozen over, but even the big rivers with their strong currents. The force of the blizzards was terrific. That of the end of March, 1905, showed on our anemometers a velocity of no less than 120 miles an hour, and for a whole sixteen hours the average velocity was over 88 miles an hour. The destruction caused to camels was terrible, and we lost hundreds at a time. The blizzard of March, 1905, killed in four days no less than 200 camels. I may note here that from one cause and another we lost 4900 camels during the two and a half years of our work.

Winter and summer work had to be carried on at full pressure. There were extensive topographical and hydrographical surveys to be made, and information of all kinds to be collected. The actual marking out of the boundary-line with pillars after the course of the boundary had been settled was a difficult task. One hundred and ten miles of it was through a waterless desert, both mountain and plain, where water had to be brought for men and beast from long distances, and about 100 miles lay along rivers and through swamps and lakes. The wear and tear of our work was, of course, very trying to men, and we lost fifty men in all. The mortality list itself is a record of the varying conditions of country and climate, for we lost two men from heat, seven from heat and want of water, three from being frozen to death, and four from drowning.

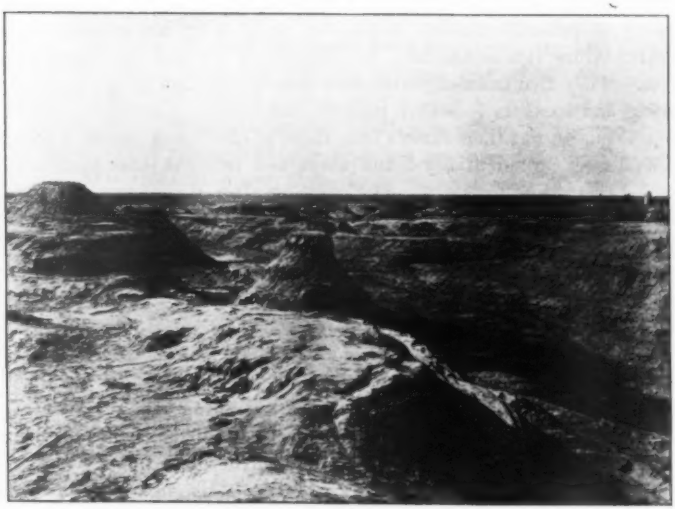
The history of the seven who died from heat and thirst is one of the saddest chapters of our mission history, but it affords a splendid instance of the zeal for work and devotion to duty which our Indian native fellow-servants of His Majesty possess. The disaster was due to that burning desire which possesses the breasts of geographers, British and native, to fill up those blank spaces now getting so few and far between on our maps. The Dasht-i-Margo had always been one of those blanks. Many have skirted its edge; none had entered it. To one of our most distinguished native surveyors, Khan Bahadur Mohiuddin, fell the duty of being the first to attack this tract, and none were so keen as himself to do so. He was an old surveyor, and especially well accustomed to work in a waterless country. He started from the Helmand, near Chahar Burjak, with a well-equipped party of four chain men, two camel-men, and four guides. Zeal took him further than

A TYPICAL MOVING SAND HILL (BURKHAN).

prudence would dictate, and one evening three of the guides, after trying to persuade Sheikh Mohiuddin to give up his enterprise and return before it was too late, determined to try and save their own lives. They tied themselves on their camels, and tied their camels in a string, and let them go where instinct took them. The riders soon lost consciousness, but their camels took them to the Shand, where a hunter of wild asses providentially found them, and brought them to life, and guided them back to safety. The morning after their departure found Sheikh Mohiuddin and his party with no water left in their water-bags, under the fierce heat of the sun on a scorching plain. A portion of the party dug for water in a dry nullah-bed close by, but without success, and the only relief they got was by throwing the cool dug-out sand over their burning bodies. One of the party, their last remaining guide, collapsed, and the others went back to find Sheikh Mohiuddin lying dead, with his horse lying dead beside him. The two camel-men had disappeared, no one knew where, and the four remaining men of the party, the four chain-men, found themselves alone. One of their number, Saidu, whose name deserves to live in the annals of heroism, put duty before other considerations even at that awful crisis. He cut off from Sheikh Mohiuddin's plane-table the precious map for which so much had been risked, and, knowing he could not long retain consciousness, wrapped it round his waist in his waist-cloth, and started off with his three comrades, in the fond hope of finding water, they knew not where. They

struggled on that day and all night, and the next morning three fell, unable to proceed. The brave Saidu stumbled on. He says he soon lost consciousness, and when he next came to, he found himself at night half lying in a pool of water. There a wandering Afghan found him, and carried him on his back to Chakansur, which proved to be close by. There our kind Afghan friends took great care of him, and after some days, when he was able to be moved, they brought him back to us. Thus was the first portion of the blank of the Dasht-i-Margo filled up and its survey preserved. It cost us seven valuable lives. The search parties which we subsequently sent out to recover the bodies of Sheikh Mohiuddin and his ill-fated companions filled up some other portions of this blank.

In the last winter of our stay in Seistan, a new and quite unheard-of plague visited the country and us. First the jackals, which swarm in the country in huge packs, went mad and attacked men and animals. Four of our men were attacked and bitten, of whom one died of hydrophobia. Then the numerous wolves of the country went mad too, and played havoc in the villages and encampments of the wandering nomads. Tales of damage to men and animals, and of deaths from hydrophobia poured in from all sides. Mad dogs also were most unpleasantly numerous. And as Seistan swarms with village pariah dogs and the big fierce dogs of the nomad people, Seistan had a very lively time of



TYPICAL WIND SCOURS IN THE SOR-DAGHAL TRACT OF SEISTAN.

it. The local people, much as they value dogs for protecting their flocks from wolves and themselves from thieves, killed nearly all their

dogs, and a wholesale destruction of our canine companions became necessary in the mission camp, and every possible precaution was taken to protect our camps from the onslaughts of mad animals. A terrible incident, however, occurred.

On the night of March 25, 1905, when the big blizzard was raging, a mad wolf, or perhaps two wolves, time after time throughout the night attacked the camp of our camel corps. The darkness, and the chaos of noise and wind and driving sand that was raging, prevented the men from seeing the wolf or wolves and killing them. It was found next morning that a horse and no less than seventy-eight camels had been bitten and ravaged. Of these, no less than forty-eight sub-

A WINTER CAMP OF THE SEISTAN MISSION NEAR THE HAMUN, SHOWING BURNING REED-BEDS IN DISTANCE.

sequently developed hydrophobia and had to be destroyed. The horse also went mad.

All things have an end, and this merciful rule applied, I am glad to say, to our stay in Seistan. The work of arbitration was at last accomplished, and on May 15, 1905, our mission started back to India. We returned by the trade route, through Robat and Nushki, and had a very trying time crossing the desert at the very hottest season of the year. We had, of course, to march at night, for the heat in the daytime was very severe. We only lost one man on the march, a poor levy sowar, who wandered from the road, and whose dead body and that of his horse our search parties subsequently found in the waterless tract to the north of our route.

The temperature during the last week is perhaps worth notice. The daily maximum in the shade that week was 113°, 116°, 120°, 119°, 122½°, 120½°, and 119½° Fahr. You can therefore understand our pleasure in reaching the cool highlands of Quetta on June 17, and finding ourselves, after two and a half years of the wilderness, back in civilization once more.

Let me say a very few words in conclusion. Many may infer, from what I have said of the delights of life in Seistan, that it is a most undesirable place to reside in. It must be remembered that our experiences are based on a life in tents and on outdoor work carried on all the year round, generally in the wildest and worst parts of that country. If one had a comfortable house and its civilized conveniences for mitigating heat and cold, keeping out insects, and so on, Seistan would not be so very dreadful a place to live in as I may have depicted.

The old ruins that testify to the populousness, wealth, and prosperity of Seistan in the past, show that it must also have been a popular resort. Most of the evils and discomforts of present life there are due to the triumph of chaos over civilization, and nature has, as she always does in such cases, wreaked her vengeance on the country. Increase of cultivation would do much to remove the insect plague, affect the climate, and check the destructive agencies of nature, which now work their will unfettered and unrestrained. Seistan might, by human agency, be made once more a country pleasant to live in.

The extraordinary fertility of its soil, even under present conditions, makes it a country of enormous latent wealth and vast possibilities. Its geographical position and natural resources, both in grain and cattle, render it a place of great strategic, political, and commercial importance. If any one doubts this, let him study the extraordinary efforts our Russian rivals have made and are making to supplant our influence and establish their own in Seistan.

I feel painfully cognizant that this paper has many shortcomings, but Seistan, with its many aspects and problems, is too large a subject to treat in so short a space, I have not been able to allude to many of the branches of work to which we devoted our energies during our stay in Seistan. Of our political work I need say nothing, but, besides geographical and the archæological work I have referred to in this paper, much valuable ethnological, meteorological, geological, zoological, botanical, and other work was done. The results are all being carefully recorded, and will, I hope, assist future workers in this most interesting of countries.

Before the paper, the PRESIDENT: For Colonel Sir Henry McMahon there is no need whatever for any words of introduction, or that I should delay you for a moment. I will at once call upon him to read his paper on "Recent Survey and Exploration in Seistan."

After the paper, the PRESIDENT: When Sir Henry McMahon was despatched

upon his journey to Seistan, he was sent there by a statesman whose name will live (so long as the English dominion remains in India) as one of the very greatest of our viceroys, Lord Curzon of Kedleston, and I am sure you will be very glad if Lord Curzon will say a few words on this occasion.

Lord CURZON OF KEDLESTON: I have never had the ill fortune to visit Seistan myself, but yet in one way or another I have had a great deal to do with it. When I wrote a book upon Persia some fourteen or fifteen years ago, I called attention to what then seemed to me to be its very great commercial, political, and strategical importance. All subsequent investigations, of which those recorded by Sir Henry McMahon to-night are the most important, have, I think, tended to confirm the accuracy of those forecasts. Then when I was in India, it fell to my lot to do a good deal to encourage the trade route to Seistan—the latest method adopted by ourselves for increasing the beneficent influence of Great Britain in that part of Asia. I was responsible for erecting that not uncommodious building above which flew the British flag in the picture that you saw earlier in the evening. And perhaps not the least of the services that I have ever had the opportunity of rendering in connection with Seistan was in dispatching Sir Henry McMahon to conduct the mission which he has so modestly recorded to-night. The matter rose in this way. Seistan is a country, as he indicated to us, which possesses two remarkable features. The first is its physical position at a point where the dominions of Persia, Afghanistan, and Great Britain touch; the second is the fact that so much of cultivation, wealth, and possibilities for the future as it enjoys is due to the river Helmand. These conditions, however, both political and physical, are such as from time to time lead to trouble. Thirty years ago, or more, that eminent man, Sir Frederic Goldsmid, who used to be one of our foremost supporters in this Society, conducted the first Seistan Demarcation Commission, and the results of his labours have been recorded in the book which has been the *locus classicus* on the subject ever since. Circumstances subsequently changed. The river Helmand continued to wander, and part of Sir Frederic Goldsmid's demarcation had never been completed. Difficulties arose on the subject, which terminated in collision between the Persians and the Afghans. Under the terms of an old treaty, it was for Great Britain to compose these differences, and under the constitutional powers which I enjoyed, it was for me to appoint an officer to do it. Out of the whole of the officers available for the purpose in India, I had no hesitation in selecting Sir Henry McMahon for the task. I regard him as one of the very best of that able and efficient band of officers who are trained up to the work of empire on the frontiers of India, and who are capable of undertaking any task which may be placed in their hands. His frontier experience is absolutely unique along the whole line that separates India from the country either of Afghanistan or of the Baluch tribes, and upon every section of it Sir Henry McMahon has left his mark. Possessing a mastery of the sciences required for boundary demarcation, a faculty for dealing with native tribes not uncommon in India, though hardly known to those at home, and a capacity for discharging all the duties requisite in officers engaged in frontier work, I felt that Sir Henry was the man to carry through this particular job. Now we have listened to his paper this evening. I have called it a modest paper; for it appeared to me to err on the side of depreciation of the extreme difficulties and discomforts, and I might say dangers, that attended his task. You perhaps have heard enough to realize that Seistan is one of the most unattractive, the most inhospitable, I had almost said the most odious of places in the world. It is a country of marshes and swamps, of sands and solitudes, of extreme heat and extreme cold, famous for a wind, the most vile and abominable in the universe, presenting at all seasons of

the year dangers to life which can scarcely be realized by those who only read of them at a distance, but the actual effect of which can be tested by the lamentable figures of mortality that Sir Henry McMahon read out just now. He told us something about the manner in which these difficulties were encountered; he told us the pathetic story of that native surveyor who perished in the gallant effort to extend the frontiers of science in the Dasht-i-Margo. But he did not tell us about the manner in which he himself, throughout two and a half years, conducted his work. It has been my lot as Viceroy of India to superintend more frontier demarcations than any other Viceroy serving the British Government in recent times. I think at one time we had no fewer than four or five boundary commissions at work, an illustration of the vastness of our range and the complexity of our undertakings. Well, at different times I have known frontier officers complain of their absence from India, or the length of their exile; the discomforts they had to experience told upon their health and spirits; they thought perhaps they were not being supported by the Government as they might be; they were confronted with local difficulties which no one at a distance could understand. From Sir Henry McMahon during the two and a half years that he served me I never heard one whisper of complaint. Throughout that time he faithfully carried out the instructions which were sent to him. He has given you no idea this evening of the degree to which he has added to the scientific knowledge possessed about that most interesting country. Only when the works which he and his colleagues have written are published at a later date, will you ascertain the actual additions to human knowledge which are the results of his mission. At the end of the time he came back, having demarcated the boundary in a manner that was satisfactory to both the Powers that were interested, and having, in addition, made an award about the difficult question of the water, which, even if it has not been accepted by both the Powers to whom I refer, will provide the basis for a settlement at no distant date. Ladies and gentlemen, I regard the Seistan mission as the model of what such a mission ought to be and of the manner in which it ought to be conducted. Seistan itself may be unknown to the majority of people of England, perhaps unknown to the majority of you before you came into the room this evening. But I believe, as Sir Henry McMahon indicated, that it is a country which has a future before it; and that on two grounds—firstly, the great political importance which was referred to by him—the very fact that Russian and British ambitions meet on this spot must render it a theatre of important diplomacy in the future; and, secondly, what concerns us more on the present occasion is this—the pictures shown by Sir Henry McMahon of the bygone wealth and prosperity of Seistan, the facts that he gave us about the fertility of the soil, and the capacity of its rivers, indicate that Seistan ought not to have a past alone, but ought one day to have a future. I myself believe there is no reason in the world—and I am very certain he will corroborate me—why, if Seistan is placed in proper hands and irrigated as it might be, it should not recover its former prosperity. I hope that day may come. I hope that the jealousy of local Powers and the rival ambitions of greater Powers outside may not retard its arrival, and when it does come, one of the facts that will best enable us to ensure the full realization of these hopes will be, I am convinced, the labours that Sir Henry McMahon has related to us to-night.

The PRESIDENT: A reference was made in the paper to Field Marshal Sir George White; perhaps he will be kind enough to address a few words to us.

Sir GEORGE WHITE: I have, not very far from Seistan, found myself more than once in a very tight place, but I have never in the course of my whole military career, which has extended now to over half a century, found myself in a position in which I felt less capable of coping with the position before me than I do at this

moment. I have listened with the most intense interest to what Sir Henry McMahon has laid before us. I have listened also with delight to the eloquent and high appreciation of that officer's services which has been given to you this evening by him who of all others is in a position best to appreciate those services and to give it eloquent and full expression. I have myself often rejoiced when I have heard of the horrors of Seistan. It may be that I have taken a view which I ought to be ashamed of, but I hope, from certain indications that have been put before you this evening, that it may become more a chamber of horrors than it is at present. I cannot imagine a position such as that on the borders of Hindustan being anything but a dangerous avenue of approach for those who will not, I think, increase the civilization of that grand empire of ours which is ruled by men like his lordship who has just sat down, and by that grand civil servant to whom his lordship has paid so just and so true a tribute.

The PRESIDENT: The hour is late. We had intended to call upon several speakers, and if any one wishes to address the meeting we shall be delighted to hear him, but we have had two important ceremonies to-night, and I think we must now content ourselves by passing a hearty vote of thanks to Colonel Sir Henry McMahon for his most interesting address.

Colonel C. E. YATE, owing to the lateness of the hour, was unable to speak, but noted what he was going to say as follows:—

"I congratulate Sir Henry McMahon most heartily, not only on the wealth of geographical problems that, as he has told us, he has submitted to the Research Committee for solution, but on the large amount of information of a little-known country that he has been able to condense within the limits of a lecture of just an hour's duration.

"Sir Henry has not given us a very fascinating account of the climate of Seistan, but we must remember that blizzards and inundations, flies and winds, are not always present there, and I was glad to hear Sir Henry say at the end of his lecture that, given a good house and civilized conveniences, Seistan, after all, would not be such a very undesirable place to live in. For my own part, I have no hesitation in saying that I would much rather be quartered in Seistan than in any hot-weather station in the plains of India.

"The brief summary that Sir Henry has been able to give us of the history and antiquities of Seistan shows of itself what interest pertains to the country. Sir Henry has told us of the curious above-ground tombs that he found on the top of Koh-i-Khwajah, and he stated that the use of these tombs was obvious. They were merely the temporary resting-places of the dead till the bodies could be removed by their relations for permanent burial in the shrine at Meshed. In this, I regret to say, I cannot concur with him. When I was at Koh-i-Khwajah, I saw the bones of the dead lying in several of these tombs, and those bodies, at any rate, had not been removed. We must remember, too, that it is not only on Koh-i-Khwajah that these above-ground tombs are found. I found them at Hauzdar, Ramrud, and down the banks of the Shelah as far as the Gaud-i-Zireh, and also along the banks of the depression in which the curious ruins of Tarakun now stand. Inside the mausoleums near Tarakun the tombs were better preserved than those outside, and though they had all been opened at the end like the others, it appeared to me that they had been opened for the purpose of rifling the bodies, not of removing them. I could see the bones lying inside, and also the cloth in which the bodies had been wrapped. Now, when I saw this cloth I was at first tempted to think that these graves could not be so very old after all; but when one thinks of the vast age to which cloth in tombs in Egypt has been preserved, there is no

reason why cloth in the equally dry air of Seistan should not be equally well preserved. Had these tombs been temporary resting-places only, we surely should have found similar tombs in other parts of the country around Seistan, and on the road to Meshed, but I have never seen or heard of such tombs anywhere except in this south-west corner of Seistan, and though who the people were who built them and when they were built there is nothing as yet to show, still I cannot help thinking that when built they were built as permanent graves, and not as mere temporary resting-places.

"The graphic description given us by Sir Henry of Sar-o-Tar, on the right bank of the Helmund, is the first account of that place that has been given to the world. When I was in Seistan, all the coins and seals and old relics that were brought to me were said to have come from Sar-o-Tar, and I longed to be able to explore the place, but I could not get the chance. Sir Henry and his companions have been more fortunate, and now we know that the ruins of Sar-o-Tar exceed all other ruins in Seistan in extent, and also that the eastern bank of the Helmund was the main seat of population in Seistan's most prosperous times.

"The story that Sir Henry has unfolded to us of three deltaic areas and three separate irrigation systems, each with its own hamun, or lake, for flood waters to escape into, is an entirely new revelation. First, we have the system that drained into the Lalla Nawar, a depression never heard of before, on the right bank of the Helmund, in what is now Afghan territory. Secondly, we have the Tarakun-Ramrud system, which drained into the Gaud-i-Zireh, and is now half Afghan and half Persian; and, thirdly, we have the present Band-i-Seistan system, draining into the Hamuns on the north, which is entirely Persian.

"The pity of it is that the Tarakun-Ramrud system should have been cut in two as it has been. If you look at your maps, you will see that the present boundary-line from Band-i-Seistan to Koh-i-malik Siah runs right through the middle of this system. Sir Henry has already told us of the persistent obstruction and hostility shown by the Persians to Sir Frederic Goldsmid when he was deputed to settle this frontier in 1872. His movements were restricted, and difficulties of every kind were placed in his way. I need not dilate on this further now than to say that had Sir Frederic Goldsmid been permitted by the Persians to examine the southern portion of the frontier which he was deputed to settle, I cannot help thinking that he would have drawn the line to the north of Koh-i-malik Siah, somewhere along the dividing-line between the Tarakun-Ramrud and Band-i-Seistan irrigation systems. As it was, owing to the restrictions placed upon his movements by the Persians, he was compelled to lay down his boundary at haphazard, and Koh-i-malik Siah being about the only fixed point that his survey officer had been able to get a shot at in this part of Seistan, he simply drew an imaginary line on the map from Band-i-Seistan to Koh-i-malik Siab, without ever having been able to examine the ground across which that line was to run. As the head of the canals that formerly irrigated Tarakun and Ramrud are in what is now Afghan territory, somewhere near Band-i-kamal Khan, the result is that, so long as Tarakun and Ramrud remain with Persia, they can never be cultivated, and must always lie waste, as the water to irrigate them can only be drawn from Afghan territory, and that is impossible under present conditions.

"When I was in Seistan I was told that in very high floods water from the Helmund still found its way into these old canals, and this would seem to show that, were only these canals brought under one administration from head to tail, the Tarakun-Ramrud tract might be recultivated at no very great expense. That this part of the country was once very prosperous there can be no doubt.

"Sir Henry has referred to the extraordinary profusion in which broken

pottery is found in this portion of Seistan, testifying to the large population of ancient days. I was much struck by the same thing, and I specially mentioned it in my book on 'Khurasan and Sistan,' published in 1900. I can recall to mind one mound in particular, called by the Seistanis Shahr-i-Sokta, or the burnt city; not that there was any visible sign of a city, but the ground on every side, as far as the eye could reach, was one mass of broken pottery, while my local guide kept continually turning up the ground to show me that the soil was black and burnt, and that we really were on the site of a burnt city.

"Now, whether the denudation of Seistan of trees, that Sir Henry has mentioned, is due to this burning and to the general destruction and desolation that overtook Seistan at the hands of Timur Lang, or to the wind, as Sir Henry has suggested, has yet to be proved. Personally, I am of opinion that it is not due to the wind. I myself saw tall trees growing on the banks of the old bed of the Helmund at the Afghan village of Deh Ido, in the north, and if these trees can grow, others can grow. Again, at a place called Machi, near Ramrud in the south, I found the roots of date trees still visible in the ground. Apparently the town of Machi, of which the ruins now only remain, was formerly surrounded by large date groves, and if these date groves existed in former days, why should they not exist now? All that is required is good government. Under Persian government there is no security of tenure and no hope of improvement. Seistan, as Lord Curzon has just told us, undoubtedly has the capabilities of a great future before it, and, given a good and stable government, there is no reason why it should not blossom out again into the semblance of its former self, and become the populous, rich, and prosperous country that it was in the past."

The following discussion took place at a meeting of the Research Department on May 11, when Sir H. McMahon introduced the portion * of his paper dealing with the problem of the Seistan basin.

Before the paper, the CHAIRMAN (Sir THOMAS HOLDICH): It will be fresh within the memories of you all that not so very long ago Sir Henry McMahon read a paper before the Geographical Society in which he outlined some of the geographical conditions of Seistan, but on that occasion there was no time for discussing the subject further. He will now give us a few more details on the same subject, which I think ought to give rise to some very useful discussion. I will ask Sir Henry McMahon to read his paper.

After the paper, the CHAIRMAN: The interesting paper which Sir Henry has just read to us recounts to a certain extent what he put before us the other night at the larger geographical meeting. But there is just one point to which he does not refer to-night, to which, if you will allow me, I should like myself to refer. I wish to record my deep appreciation of the kind and sympathetic record which Sir Henry McMahon has given of an old and faithful servant of mine, Sheikh Mohiudin, who died whilst prosecuting his surveys under Sir Henry's direction. You may possibly remember that he died of thirst in the desert, and that one of his assistants was rescued by a passing Afghan with his plane-table sheets wrapped round him so that they might not be lost. Such devotion to duty as that, fortunately for us, is not an uncommon feature in India. Every one of us who has lived long in India must have known many instances. What is, perhaps, more rare is that such devotion, such loyalty, should be so fully and sympathetically recognized as it has been in this case by Sir Henry McMahon. I think it is that peculiar

* *Vide* portion of Sir H. McMahon's paper in brackets at pages 216 to 227 of this *Journal*.

sympathy with the native character, that grasp of the idiosyncrasies of the natives, the understanding of their manners and their methods, which have strengthened the hands of such men on the frontier as Nicolson and Sandeman; and I think it is quite possible that to those illustrious names hereafter the name of McMahon will be added, because he too possesses exactly that same grasp of the peculiar point of view from which the native regards his work in India in connection with us, and the same sympathetic spirit which leads him to make friends with natives wherever he meets them. Now, such men are bound to succeed; they will always succeed, for this reason—that they will always be well and faithfully served. And now just to refer for a minute to his geographical problem. He has put before us very much the problem which Charles II. placed before the Royal Society: "Given a bucket full of water, if you put a fish into it, why does not the water spill over?" As a matter of fact, it does spill over; and so I think that, as a matter of fact, the silt which is carried into that big Seistan depression finds its way out again, and Sir Henry himself has given us the explanation of the manner in which it is carried out. I believe myself that it is two great forces of nature, constantly acting and reacting, that keep the level of the Seistan basin tolerably constant. Sir Henry has stated that he found an abnormal amount of silt in the river Helmand, but he took his observations at the Band i Seistan, at the point where the Helmand enters the Seistan depression.

Sir Henry McMahon: We kept constantly making observations throughout the river, everywhere in the deltaic area.

The Chairman: It is a curious fact that one writer after another has recorded of the Helmand river above Seistan that it is remarkably clear, and such certainly is my impression. I should say that this is a problem of the circulation of silt within the limits of the Seistan basin. As you observe, the main course of the river within Seistan is a little west of north; that is precisely the direction, again, from which the wind blows. Now, the wind cannot get at the silt when it is under water; but there are times, after extensive evaporation, when the silt must be subjected to the action of the wind, and that extraordinary erosive action which Sir Henry has described to us so graphically is certainly sufficient to carry anything that is not absolutely consistent and solid away from Seistan. I observed myself, amongst the many ruins which surround Seistan, the curious way in which these ruins, built of sun-baked bricks, are actually blown by degrees into space; the action of the wind is such that they grow positively less year by year. So I am inclined to think that the silt of the Seistan basin may be found scattered pretty widely over the almost illimitable deserts to the south and south-east of it. I may say that the problem of the wind is by no means a local problem, for that terrific north-west wind which blows so strongly in Seistan, and has proved so exceedingly inconvenient to the working of the commission, is encountered all the way northwards from Seistan to Herat, and from Herat across the Paropamisus, until you reach the country which the people call the "home of the wind." Even there you are not at the back of it, and, so far as I know, it is really a continental wind pervading all high Asia. The same problem of scooped-out depressions, and of the accumulation of surface soil gradually moving southwards in front of the wind, is to be found all over Asia, especially in the Chol country which is north of the Paropamisus, and to a certain extent all loess formations are due to wind-action.

There is just one other thing that I should like to point out, and that is Sir Henry's reference to the extent of cultivation that once existed in that country, and to the possibility of that cultivation being revived. Now, I myself am very doubtful whether there was ever any very large massing of population in Seistan. I do not think that the number of villages which you see scattered over this map

are any criterion whatsoever of the number of inhabitants that ever occupied that country. He has pointed out himself how very soon a village disappears under the influence of wind and collected sand; consequently I believe that never at any time were more than a very small fraction of those villages inhabited. I think it is quite possible that what takes place in the Takla Makan desert far to the north is what has taken place here—that villages are covered with sand and again uncovered; that they are occupied at one time, lost, and possibly recovered afterwards; but that at no one time has there ever been any vast accumulation of the human race in the Seistan basin; and, so far as I could see, when I was in that most uncomfortable country, there was no room for a vast amount of cultivation either. The area is not very large; and although Seistan originally figured in classical history as the granary of Asia, that was in the days when very small granaries went very far; and I take it that the position of Seistan, which is very much analogous to that of Herat, has given rise to an undue appreciation of its wealth, it being the only green spot in a huge illimitable waste of sand and desert. There is just one other point which is interesting, which is the curious isolation of Seistan. The map showed you how the waters overlap it on the north and on the west, and occasionally curve round in times of flood to the south. This is a very curious geographical peculiarity; I do not think that I know of any other inland country in the world so entirely shut off from communication by natural causes as Seistan. I hope that we shall have further discussion on the subject of the curious problem which Sir Henry has put before us, which I take to be this: "Why is it that the Seistan depression does not gradually diminish? How is it that it is not filled up with the extraordinary amount of silt which the rivers carry into it?" We ought to have some interesting theories put forward by some of the members present.

Dr. Teall: The paper is one of extreme interest, both from a geographical and from a geological point of view. It comes, moreover, at an opportune moment, for just now the phenomena of denudation and deposition in arid climates is exciting a considerable amount of attention. Sir Henry has given us a vivid picture of the geographical conditions of a most interesting region, and he has submitted at least two important problems for discussion. How is it that the great depression does not become filled up with sediment brought down by the rivers? and how is it that the Hamun is not a salt lake?

With regard to the first of these questions, I can see no escape from the conclusion that either the area has subsided or the material has been removed by the wind. Sir Henry gives us no direct evidence of subsidence, but he shows that the second cause is undoubtedly operative. May it not be sufficient? On this hypothesis, we should have to assume that the changes in the past history of the district were somewhat as follows. In the earlier stages the amount of material brought into the area in question would be in excess of that amount removed by the wind, and the depression would fill up, though it may not be necessary to suppose that the whole of the basin would be filled up, say, to the level of the surrounding plateau. At a later stage the amount of solid material imported by the rivers would be less than that exported by the wind, hollows would be formed, and erosion of the previously deported alluvium become possible. Sir Henry's graphic description of the effects of the wind makes it not improbable, to my mind, that the amount of solid material exported from the district as a whole by this agent may at least equal that imported by the rivers. Then as to the second question, it seems to me that we are driven to the conclusion that the Hamun is kept comparatively fresh by the periodic flushing during seasons of flood.

Mr. G. W. Lamplugh: In Europe, China, and North America, huge deposits of loess are believed to have been accumulated by the action of wind in past times;

and recently it has been brought before us by the work of Dr. S. Passarge in the Kalahari, that the wind is effective, not only in depositing material, but also in planing down the surface. Dr. Passarge believes that the large smooth plains of the interior basin of South Africa, which we had supposed to have been formed by the long-continued base-levelling action of rain and rivers may have been formed mainly by wind-erosion. If his view be correct that a peneplain can be developed by this agency, we should have little difficulty in believing that a depression such as that described by Sir Henry may have been developed by the same agency. But at present we have no measure of the amount of material that can be removed by the wind; and if Sir Henry could give us any idea of how much light material may have been carried outside this particular drainage basin in this way, it would be extremely helpful. It appears probable that much of the lighter material must be so transported, because the sand-dunes, I suppose, represent only the heavier grains of the land-waste, which one might compare with the gravels of a river-bed, while the fine dust derived from the loams and silts that are being eroded so rapidly is apparently not left in the dunes. But this dust must have gone somewhere, and one would like to know if it may possibly have been blown over the edge of the interior basin to the slopes that drain down into the ocean, where, of course, the rivers could readily carry it away to the sea. If this has happened, it might explain the deepening of the hollow.

With regard to the possibility of the depression being caused by the weight of the sediments, we find, in the geological record, many instances of deposits of great thickness that must have been piled up in water that remained persistently shallow; but we do not yet know in such cases how to distinguish between cause and effect. Whether the sediments weighed down the bottom, or were accumulated because the bottom was sinking from other causes, we should obtain practically the same result. But in the Seistan basin it seems probable that the lake-waters at one time stood much higher than at present, and were much deeper. Now, the weight of this water itself would, I take it, be greater than the weight of the sediment that has since been carried into the bottom of the basin, so that we cannot be certain that the total load has so steadily increased. On this point we may recall that the possible effect of water-load in depressing a lake-basin has been discussed by G. K. Gilbert, who found that the old beaches of the dried-up Lake Bonneville, in the Great Basin of North America, have been deformed by differential crust-movement, and now rise slightly toward the centre of the old lake where there was once the deepest water; and he therefore conjectured that the weight of water may have been effective to some extent in depressing the basin.

Prof. Garwood: I have been interested, like the rest of us, in the problems brought forward this afternoon. I am in hopes myself that Sir Henry will succeed in proving the depression of the area. It is a subject I am specially interested in, because the corollary of it, *i.e.* the possible elevation of a country where material had been removed, has come under my own notice, and consequently where you have deposition taking place you should get depression. It is rather a thorny subject, I think, to the geologist how this depression would take place. But as regards the elevation, we have very good instances where denudation has taken place; in Norway and Sweden, for instance, where the ice-sheet has melted away. There the axis of the greatest elevation coincides practically with the axis of the maximum glaciation during the glacial epoch. You have the phenomenon of the youngest trees nearest the coast, and the absence of human habitations along the coast belt. In many cases I have noted what seems to me only explicable on the supposition of recent elevation, both in the Himalayas and the Alps: the presence of such phenomena as hanging valleys, due, I must say in my

opinion, to elevation, connected with the melting of ice-sheets and glaciers in old glaciated districts. The corollary of that is, that where deposition has taken place there you should get depression, and I should be very pleased to see Sir Henry McMahon prove his contention.

Mr. STRAHAN: One of the results of this discussion is to show, I think, the danger that we may get in of arguing in a circle. As far as I understand it, we have arrived at the conclusion that the ground is sinking in the Seistan because the sediment has been deposited in it, and we have arrived also at the conclusion that the sediment is being deposited in that depression because the ground is sinking. That is as pretty a circle as I have heard in a good deal of experience of geological argument. The Seistan reminds me to compare the very small with the very great, of what may be seen in the Val d'Arno above Florence. There what has once been a large lake has been filled with a more or less horizontal deposit to a high level. The outlet of that depression has been deepened by the river Arno, with the result that the deposit in it has been partly eroded to a lower level—the "terra nuova," as they call it, the upper and original level being known as the "terra vecchia." In the case of the Seistan we have no outlet, and the only possible reason for a lowering of the level comparable with that of the upper Val d'Arno is the falling of the level of the water in the lake; and I would ask whether there is any evidence that the water of the lake has stood at any greatly higher level than it does now. The difficulty in the way of a theory pure and simple of depression appears to me this: that the lake is more or less surrounded by an irregular cliff, I think 200 feet high in places. Now, I imagine that the depression, according to Sir Henry's theory, would affect not only the lake itself, but its surroundings. Is it to be supposed that the cliff stands at the original level, and has not shared in the depression? It is a little difficult to conceive that that can be the case. So far as regards the cause of the depression, which, of course, is an exceedingly theoretical matter, it appears to me no more difficult to conceive that a depression has taken place in the Seistan than that the mountains have been raised round it. The result, at any rate, has been a land-locked basin, the study of which to geologists is of the greatest interest, for it enables us, to a certain extent, to judge of what was taking place in such a period as that of the Trias. We have in this country good evidence of desert conditions having then prevailed, of the action of land-locked waters, of the catching of vast masses of silt or sediment, and the local deposition of beds of rock salt. Especially I was interested in the way in which it has been shown that the salt may be carried in solution to one restricted part of the basin, and there deposited, while fresh water—or drinkable water, at any rate—may prevail over other parts. In conclusion, I would only say that we are greatly indebted to one who has not only had the opportunity of studying such regions, but who has the power of bringing so graphic a description before us.

Mr. H. YULE OLDHAM: Several aspects of the question, which is a thorny one, have been discussed by Mr. Huntington in an interesting paper published by the Carnegie Institute, as I dare say Colonel McMahon knows, and any one interested in the question will find a good deal of information there. But I should like to be permitted to ask just one or two questions on this occasion. One is as regards the "120-day wind," which I notice both Colonel McMahon and Mr. Huntington describe as coming from a point to the west of north. As far as I remember, in Lord Curzon's interesting introduction to Morier's 'Hajji Baba,' it is referred to as being a north-east wind at Quetta. Perhaps Sir Henry McMahon could kindly say whether it is north-east in Quetta. No doubt it is produced by the low barometric depression in summer over India, and the wind being drawn in from the north in the Seistan district, the mountains naturally direct it as a north-west

wind; possibly, in the same way it may be north-east at Quetta, but east and west are easily interchanged by accident. Another question is as regards the spelling of Seistan. Sir John Malcolm used to spell it with two *e*'s—Seestan. I notice the Americans spell it "Si," and we have it "Sei." The two *e*'s certainly suggest the sound Seestan as does Sistan, if you use the Italian pronunciation; but the "Sei" spelling gives a certain amount of uncertainty. Finally, if I might offer one suggestion as regards that interesting question raised as to the fresh-water nature of the Hamun. I should like further information, but I rather gather that the lake is apt to dry up fairly frequently. When Colonel McMahon first went there I believe there was no water at all, but that it very rapidly filled up. Now, if the lake is liable to dry up frequently, I think it is possible that the saline deposit which has been laid down there would be blown away by the strong wind before the next flood filled it up. That to a certain extent might account for the very remarkable freshness of the water. But that, of course, depends on the frequency with which the lake is liable to dry up. Desiccation, deposition, dispersal would express the cycle of events.

Sir Henry McMahon: I must thank Sir Thomas Holdich for the kind remarks he has made about myself personally and regarding my mission. I now proceed to take up a few points that have been raised by gentlemen who have so kindly joined in the discussion. As regards what has been said by Sir Thomas Holdich himself, I will take first his remarks about the clearness of the Helmand river. That is an important point in this discussion, and I must emphasize my reply. Sir Thomas Holdich and others who have visited Seistan and written about it have nearly always happened to go there in the autumn. That particular time of the year, *i.e.* from about the last week in September to the end of October, is the only period of the year in which the water of the Helmand can be said—at any rate, the portion that we know of it, some 100 miles or so—to be at all clear. In proof of this, I may mention a fact which will appeal to those who indulge in the gentle art of fishing, *i.e.* that this is the only period of the year in which the water is clear enough for the successful use of a spoon. During the rest of the year the river is very thick and muddy. The river begins to rise early in November, goes on gradually rising, getting muddier and muddier, until it becomes after Christmas a thick chocolate-coloured flood. We know that a lot of silt comes down the river, and I have mentioned to you an instance of where ruins have been buried under 18 feet of silt. We were in Seistan nearly two and a half years, and Mr. Ward took observations of silt steadily through all that time, and has calculated that the average deposit of silt brought down by the Helmand alone in one year is sufficient to cover 10 square miles a foot deep. Then you have the other rivers to consider as well. I must emphasize this point, because if there is no silt coming into Seistan, then it is obviously unnecessary to explain what becomes of it. I repeat, therefore, that the Helmand is a river with an extraordinary amount of silt, taking it month in and month out throughout the year. But apart from the silt that now comes down in the river, what has become of the *débris* of the cliffs? Then the next important factor in this problem is the wind. Sir Thomas Holdich rightly points out that the 120-day wind is a continental wind. I do not claim for one moment a monopoly of that heavy wind for Seistan by itself. We made very particular and careful inquiries about the wind for scientific purposes. I had with me representatives of Herat and other distant parts of the country, and the consensus of opinion, never disputed by any of those who knew the country, was that this wind prevails northwards, right away into Russian territory. It is very strong at Herat; it is not felt in the mountains on the east border of Persia; and (I now come to an interesting point) the place of its

maximum velocity and force is at Lash Jowain, just at the north end of the Seistan area. It continues in great strength throughout Seistan, but south of Seistan it diminishes, until when you come down to the trade route you hardly feel it at all. You do get winds along the trade route during the period of the 120-day wind, but these are not of the same strength or constancy, and, moreover, blow in varying directions. We kept a very careful record of the Seistan wind, and find that it blows from between 316½° and 333¾°, *i.e.* from a little west of north. I will not go into the question of the extent of past cultivation in Seistan, beyond simply saying that Seistan has been much written about from the very earliest times of Eastern literature, and we have in these old records repeated references to the great prosperity and wealth of Seistan. I do not for a moment say that there is not a natural tendency to exaggerate the population and the wealth of the past; but we have a lot of records which refer to it. It was striking enough, at the times in which those records were made, to be mentioned by the writers. As regards the past extent of cultivation, I must note that when Sir Thomas Holdich passed through Seistan, by far the greater portion of the country, and the portion where the greatest cultivation and prosperity of the past existed, *i.e.* the Tarakun and Sarotar tracts, was a *terra incognita*. Dr. Teale goes into technical details, and he speaks about the absence of direct evidence of subsidence. Mr. Garwood, later on, hopes that I shall be able to prove some evidence of subsidence. Well, it is a hard job to give me. The only direct evidence I can give of a gradual subsidence of that area is the fact that I mentioned, *i.e.* that the older river-beds are at a higher level, and yet at approximately the same easy grade as the present river down below them. This fact, in my mind, would tend to show that when those rivers were running, the level of the lake-bed was higher than it is now, and therefore those rivers had no cause to hurry themselves, or to go down a steep slope into a hole, but were going into a depression of the same relative depth below them, and therefore at the same leisurely pace as the present rivers go into the present Hamun. That is the only evidence I can give, and I give it for what it is worth. Then Dr. Teale asked if the deposit of silt is greater than that removed by the wind. I am afraid, over such a big area and with a wind like we had to deal with, I have no data on which to really give a definite answer. As regards the wind being less in the Gaud-i-Zirreh, and the suggestion that the focus of the wind may have changed, that is extremely likely; but of that we know nothing. One thing we do know about the wind is that the old ruins, so far back as we find them—the very oldest of them—are, like the recent ones, all built at the same angle to the wind. Their side walls are at the same angle as the present direction of the wind, their end walls at right angles to that direction of the wind, which would show that the wind, during historic periods of which we have traces in ruins, has remained at a constant angle throughout. I cannot answer Mr. Lamplugh's question as to about how much light material the wind has transported. In all the vast Baluchistan desert south of Seistan, on which I read a paper about nine years ago, what strikes one most forcibly is the enormous accumulations of sand-hills and sand-mountains piled up all over the country. That would be, as he says, the heavier material, the sand (silica), not the finer silt. I do not know what becomes of the lighter material. About Mr. Strahan's query: "Has water in the lake stood at a much higher level than now?" I do not know whether he means if the actual water was deeper, or whether the bed on which the water stood was higher than now. On the latter point I have already made a reply with regard to the level of the river-beds. But if he asks whether the water was deeper, and whether there was more water in these lakes in old days than now, I am unable to give a definite reply, at any rate regarding prehistoric

times. If, however, we go back to old historic records, it is a very curious thing that, as far back as I have had access to them or had them quoted to me, everybody writing about the lake of Seistan nearly always describes it as being 100 miles long and about 15 miles wide. This is how one would describe it now, and so it does not seem to have been materially larger than it is now. The old river-beds, the old canals, bear about the same proportion to the river as the present beds and canals do now. As regards other questions, of course we studied Mr. Huntington's paper very carefully. Mr. Huntington was not long enough in this country to give a very definite opinion on the various points, and he ascribes these various phenomena which I am talking of to climatic oscillations, and to glacial and interglacial periods, and he suggested as a possibility that the river itself had oscillated from side to side in Seistan. If I had known his doubt on this point, I could have told him that the Halmand and the Hamun have oscillated time after time from one side of Seistan to the other. The following spelling of the word, "Seistan," is the right one, because the name is a later form of the old "Sejistan," which again comes from the older form "Sakæstan," *i.e.* "land of the Scythians" (Sakæ). The Seistan lake is only known to have completely dried up once. The area of water contracts and expands according to the seasons of high and low river. The suggestion that has just been made, that the wind plays an important part in removing the salt, is a good one.

I think that is all I have to say. I am not in a position, nor would I dare, to give a final verdict as to which is the correct solution of the problem under discussion—subsidence or removal by the wind. I thank you very much for your remarks on my paper.

The CHAIRMAN: I think you will cordially support a vote of thanks to Sir Henry for this very interesting paper.

THE RIVERS OF CHINESE TURKESTAN AND THE DESICCATION OF ASIA.

By ELLSWORTH HUNTINGTON.

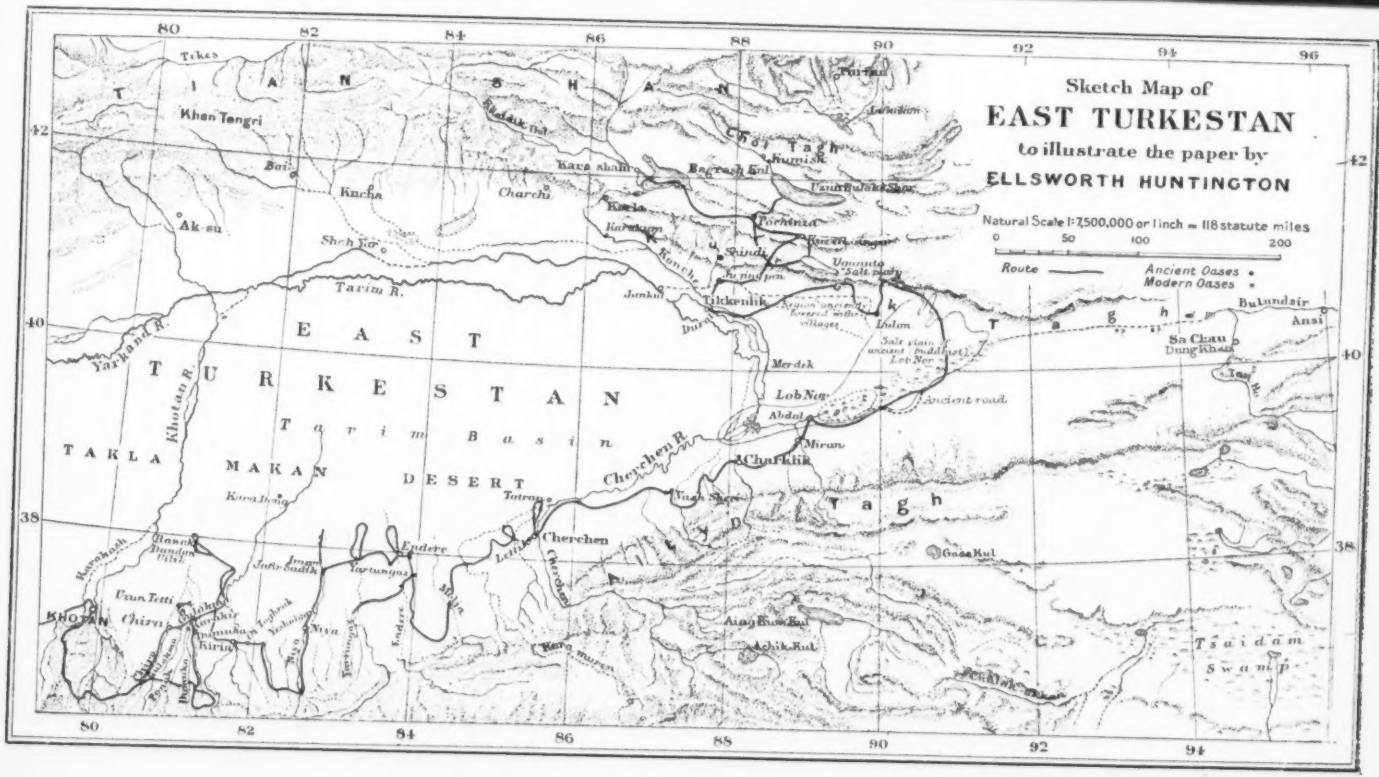
"THE desiccation of Asia" is a phrase frequently used but rarely well defined. With some writers it means the retirement of Tertiary inland seas because of warping of the Earth's crust—a process essentially completed long before the appearance of man; with others, who usually disregard the division of the Glacial Period into alternate cold and warm epochs through several of which man probably existed, it denotes the change from the coldness or moisture of glacial times to the aridity of to-day; while with still a third group it indicates a gradual change of climate, supposed to have taken place during the period covered by history, and to have been a potent factor in causing great human migrations, such as the invasion of Europe by the Huns, or of western Asia by the Turks. The reality of the first two types of desiccation is established almost beyond question by geological evidence; a study of the geography and archæology of eastern Persia, Transcaspia, and Turkestan during the past three years has led me to believe that the third type is equally real, and that during the last two thousand years there has

been in progress a desiccation of Asia which is the last faint undulation of the great climatic waves of the Glacial Period. In the reports of the Pumpelly Expedition, I have considered the question as it applies to Persia and Transcaspia. More recently, during 1905, as a member of the Barrett Expedition to Chinese Turkestan, I have been able to carry the investigation into regions where the evidence is more conclusive.

The rivers of East Turkestan fall into two main groups. One, including most of the large streams, comprises those which rise among the lofty mountains on the south-west, west, and north of the Tarim, or Lop, basin, from Khotan around through Kashgar to Korla, and join to form the so-called Tarim terminating in the historic lake of Lob Nor. The other comprises a multitude of smaller streams which rush down from the mountains, chiefly in the southern and eastern parts of the basin, and, for the most part, wither away in the desert. The latter belong to a highly specialized type peculiarly sensitive to changes in the water-supply. In the southern part of the basin, from Khotan eastward to Lob Nor, where the type is most perfectly developed, the larger withering streams, rising among snowy mountains, flow at first in zigzags or in east-and-west courses among the shallow longitudinal troughs of the northern part of the Tibetan plateau, and then, turning northward, break through the great fault-scarp of the Kwen Lun mountains in narrow gorges; while the smaller, rising on the north side of the Kwen Luns, flow down the face of the escarpment as rushing summer torrents. Reaching the sharply defined, squarely cut base of the mountains, all the streams, large or small, enter the zone of Piedmont gravels, a sloping plain from 15 to 50 miles wide. At first they flow in deep terraced trenches cut in their own gravel fans, and often difficult to cross; but soon the fans decrease in size, the terraces die out, and the streams spread into such broad and numerous channels that the water completely disappears, partly by evaporation, and still more by sinking into the gravel. To judge from the map, this is the end of the smaller streams. In reality, they continue underground as a confluent sheet, deeply buried where the gravels prevail, but coming close to the surface where the latter give place to clays and sands. Here water, often saline, can be obtained in wells at a depth of from 3 to 6 feet, and its widespread presence is shown by the abundance of reeds, tamarisks, and poplars which form a zone of vegetation from 1 to 20 miles wide, skirting the northern edge of the gravels for nearly 1000 miles. The larger streams succeed in crossing the Piedmont gravels during the three or four months of the flood season from May to August, and either lose themselves among reed-beds in the zone of vegetation, or pass on and gradually dwindle to nothing in the sand of the Takla-makan desert. The only exceptions are the Cherchen river, which, being diverted eastward along the zone of vegetation,

succeeds in reaching Lob Nor, and the smaller streams farther east which in extreme flood join the Cherchen. During the drier part of the year all the streams, except those of Chira, Keriya, and Charklik, disappear in the gravels, but reappear lower down in springs seeping out in the river-beds. Typically each main stream irrigates an oasis on the southern edge of the zone of vegetation, and formerly irrigated another, which, because of salinity or lack of water, it cannot now support. As a whole, the withering rivers show signs of having decreased in size during the last two or three thousand years, the evidence lying partly in diminished length, as shown by dead vegetation, and partly in diminished volume and increased salinity, as shown by ruins.

In the 700 miles eastward from Khotan to the eastern end of Lob Nor, seventeen rivers are worthy of notice by reason of their size or because they support oases. The test of diminished length as measured by vegetation, however, can only be applied to five of the seventeen, or possibly six, since the rest formerly united with one of the other five or with the Cherchen, which reaches Lob Nor. The possible sixth river is the small Yes Yulghun, the lower end of which has never been explored. The Molja is also doubtful. It now terminates in the zone of vegetation, but an old channel suggests that it formerly may have joined the Endere to the west, although now it is too small to flow so far. The Chira, the most westerly to which the test is applicable, appears formerly to have been joined by the three or four streams to the east of it, and to have flowed to the sand-buried towns of Dandan-Uilik and Rawak described by Stein. A strip of dead tamarisks, typical river jungle, extends even beyond Rawak, the northern town, to a point 60 miles from the Chira's present terminus, and over 50 miles from the limit of living vegetation. Farther east the Keriya river is reported by Hedin and Stein to have dead jungle extending 20 miles north of the present end of the stream. On the Niya and Yartungaz rivers I found that similar dead vegetation extends equally far or farther, and on the Endere at least 8 miles and possibly much more. In brief, of the six rivers to which the test of the extent of dead vegetation can be applied, one has not been explored; and the other five all show that within times so recent that the dead reeds, tamarisks, and poplars have not yet disappeared, the rivers flowed from 8 to 60 miles farther than to-day. The Endere and Yartungaz rivers are the most important, for they each support but a handful of farmers, eight or ten families, and the amount of water diverted for irrigation is insignificant. The Yartungaz river is now artificially constrained to flow wholly in one channel, although formerly during floods it spread into two or three. Thus the main stream has been appreciably lengthened. Yet in spite of this, the reeds, the form of vegetation responding most quickly to changes in the water-supply, are dead for a distance of 25 miles along


Sketch Map of
EAST TURKESTAN
to illustrate the paper by
ELLSWORTH HUNTINGTON
Natural Scale 1:7,500,000 or 1 inch = 118 statute miles
0 50 100 200
Route
Ancient Oases
Modern Oases
T I A N S H A N
Khan Tengri
Tekes
Baicheng
Kuche
Charchu
Ak-su
Shah Yar
Tarim R.
Yarkand R.
Khotan R.
EAST TURKESTAN
Tarim Basin
TAKLA MAKAN DESERT
Kara Buran
Tatrang
Cherchen R.
Cherchen
Endere
Tarungas
Abdal
Miran
Charkhlik
Lob Nor
Merdek
Ancient road
Tikkenlik
Toghrak Tam
Tochinza
Kum Kul
Kara shahr
Bagrash Kul
Yanar Bulak Spring
Korla
Karashahr
Kuruk Tagh
Tsaidam Swamp
Bulundsir
Ansi
Sa Chau
Dung Khara
Gasa Kul
Achik Kul
Aing Kum Kul
Kara Buran
KHOTAN
Chira
Niya
Keriya
Kara Kash R.
Yurung Kash R.
Jarkand
Yangi Hissar
Kashgar
Aksu
Turfan
80
82
84
86
88
90
92
94
96
42
40
38

the northward continuation of the main channel, which as yet is buried in sand only in the narrower parts.

The minor streams, wherever I have examined their lower ends in the zone of Piedmont gravel, have old channels never occupied now by running water, and therefore in process of being filled with sand. The channels indicate that the streams were once larger and ran farther, but in the absence of vegetation and ruins, the time of this greater size cannot be determined. The true ends of the small streams, however, as has already been said, are found in the zone of vegetation. If the streams have diminished within recent times, that is, within the period covered by history, the vegetation ought to show it. Between Khotan and Charklik, where the zone of vegetation varies in width from 10 to 20 miles, I crossed it seven times in places several miles from the larger rivers, and therefore dependent on the water coming underground from the smaller streams. In every case the vegetation of parts of the zone—usually the northern parts, more remote from the mountains—is dead or dying; and in some cases half-dead vegetation extends over the whole width of the zone. Frequently for many miles one traverses reed-beds, evidently vigorous and thick at some former time, but now consisting only of a few struggling shoots not a tenth as numerous as those of the past, the rest being mere stubble undermined by the wind. Elsewhere there are large tracts of dead and dying poplars, or of tamarisks, either dead or forming a type of mound characteristic of places where the water-supply is lessened. The death of the vegetation is often attributed to the encroachment of sand, but in the cases under consideration that has little to do with it. Often the ground is almost free from sand, there being only a few inches, or at most scattered dunes a foot or two high. And even this in most cases is not derived from a distance, but is the heavier residue left by the wind as it carries away the soil no longer held in place by living vegetation. The very form of the stems shows that death is not due to sand. In the limited region where sand is manifestly encroaching upon living plants, the reeds and tamarisks shoot up abnormally to two, three, or even four times their usual height, in a vigorous and often successful attempt to keep their heads above the dunes. In the far larger areas of little or no sand the dead tamarisks and reeds show nothing of such tall slender growth, but tend, on the contrary, to become short and stunted. The widespread death in the zone of vegetation seems to be to the smaller streams what the dead channels in the sand are to the larger—an expression of gradual desiccation.

The most unexpected and perhaps the most significant characteristic of the typical river is its ancient towns. Thirteen of the seventeen larger rivers have on their lower courses the ruins of towns dating usually from the Buddhist era, a thousand or more years ago. On six

of the thirteen rivers the ruins appear to be of only one age; on five, the Dumuka, Niya, Cherchen, Vash Sheri, and Miran, of two ages; and on the Chira and Endere rivers, of three ages. In general, the older ruins are the larger, and lie farther down-stream. Also, on the whole the ancient towns were larger than their modern successors, this being notably true of Yartungaz, Endere, Cherchen, Vash Sheri, and Miran. And lastly, with the exception of old Cherchen and Charklik, and possibly of Kara Dong at the end of the Keriya river, which I have not visited, the older ruins are situated so far out in the desert, or upon rivers so small or so saline, that it would be impossible again to locate towns of equal size in the same places, unless a far better system of irrigation were introduced.

A brief description of the ruins of Niya, Endere, Vash Sheri, and Miran will give a fair idea of the whole. Modern Niya is a town of about three thousand people, located on the southern edge of the zone of vegetation 60 miles east-north-east of Keriya. The town, like all those east of Keriya, is young, having been founded in the early part of the nineteenth century; but though it has been fairly prosperous, decay has already begun. During part of the season of irrigation the water does not come direct from the mountains, but from springs a few miles above the town. Accordingly it is slightly saline, so that the fields farthest down-stream are gradually becoming unfit for cultivation, and are being abandoned a few every year. The cultivated area, according to Stein's map, amounts to 24 square miles, including large lacunæ. Below Niya the river-bed is almost dry, but water seeps in from springs until a good-sized stream is formed, only to disappear again in the course of 20 to 25 miles. Forty miles from Niya, however, at Imam Jafir Sadik, the most famous shrine in Central Asia, the stream once more appears, but soon sinks into the earth again for the fourth and last time. In its lower course the river becomes so saline that permanent cultivation of the land along its banks is impossible. Even if there were no such town as Niya, the water, except during the flood season, would still be saline here at the river's end, and fields would become unfit for use after a short period of irrigation.

Fifty-five miles below Niya, and 4 miles below the present flood limit of the river, one comes upon the first ruins—ancient houses hidden among large tamarisk mounds, poplars, and sand. They belong to the Buddhist epoch, and have been described in part by Stein. I counted over a hundred houses extending northward for nearly 14 miles. There must be many more still to be discovered, for we found a number which were new to the guides, and one can walk within 100 feet of a house and not see it among the tamarisk mounds and sand. There must, too, be many houses buried under the latter, so that the total pretty surely amounts to several hundred. In view of the number of houses and of the large area—about 28 square miles—

apparently under cultivation—which in Chinese Turkestan always means under irrigation—the town can scarcely have been smaller than modern Niya, and must have demanded as abundant a water-supply.

At the northern end of the old town, and overlapping it for about 2 miles, there are traces of a still older ruin. No houses or walls remain, only thickly strewn pottery, bones, and slag, the pottery being of a cruder type than that of the later ruins, and broken into finer fragments. The farthest outlier of this town, so far as I could discover, lies at a distance of 24 miles from the present end of the river. Nothing is known of its history, and there is nothing by which to date it. It may represent an earlier epoch than the ruined houses, or it may merely represent the part of a single long-lived town which was first abandoned.

In either case the question arises whether with the present water-supply, which is completely utilized and is very slightly saline at Niya, it would be possible for an equally large and permanent town to grow up at a distance of from 55 to 70 miles out into the desert, and from 5 to 20 miles beyond the flood limit of to-day. Even if there were no such town as modern Niya, it appears to be impossible. In the first place, if the water at the shrine of Imam Jafir Sadik is to-day too saline to allow of permanent cultivation, it would pretty surely be as bad or worse farther down-stream. A dense population and prolonged intensive culture such as the ruins indicate would hardly be possible. In the second place, it is very doubtful whether the Niya river would reach the lower ruins even if none of the water were diverted for irrigation. A hundred years ago there were no inhabitants along the Niya river, or, at most, only a few shepherds. The river ran freely as far as it would. In the upper ruins the old channel is still visible, and the poplars and tamarisks are only beginning to die. Among the main ruins, however, and still more among the lower ones, the vegetation has been dead hundreds of years, so long that even in this dry climate the poplars are reduced to mere naked trunks, and the tamarisks have either died or grown into mounds 20 to 30 feet high. To put the matter in another way, if the Niya river was as large a hundred years ago as it was at the time of the ruins, it ought at the later epoch to have flowed not only to the ruins, but well on past the most remote of them. Vigorous vegetation ought to have accompanied it to a point at least 30 miles beyond the present end of the river—that is, 5 or 6 miles beyond the most remote ruins. But, as we have already seen, most of the vegetation among the ruins has been deprived of water for much more than one hundred years, and that at the outer limit has not only died and dried to tinder, but has been blown away by the wind so that only the stumps remain, cut off level with the soil.

The weight of the evidence of dead vegetation appears even stronger when the ruins of Niya are compared with those of old Dumuka between

Chira and Keriya. In the early part of the nineteenth century the water-supply of Dumuka gradually diminished, until about 1840 it became so scanty that all the inhabitants moved at once to the present site, 8 or 10 miles farther up-stream. Modern Niya was settled before this, but as the town grew slowly, it is safe to say that the diversion of the Niya river for irrigation did not take place on a large scale till about the time of the abandonment of old Dumuka. Since that time no surface water has reached the old site of the latter, but its vegetation is still fresh and vigorous. If an abundant water-supply was cut off from old Niya at most only twenty or thirty years earlier, it is hard to see why the vegetation should show little or no sign of death in the one case, at Dumuka, and should be completely dead and decayed in the other. It is not probable that the Niya river reached the main ruins a hundred years ago before the founding of the modern town, or that it would do so now if it were not used for irrigation. That a river of the present size could not only reach the ruins, but irrigate an area as large as that now under cultivation is still more improbable. If, however, the climate of antiquity was colder, so that evaporation was less, or moister, so that the rainfall was greater, and if the river was correspondingly larger, not only would this be possible, but the difficulty from salinity would disappear.

The Endere river, 60 to 70 miles east of the Niya, though larger, has no proper oasis. At its lower end, eight or ten shepherds have cultivated a little land during the past thirty years; but the river is too saline to admit of permanent irrigation. The shepherds say that even fresh land can only be cultivated once in three years, and any attempt at prolonged cultivation would be futile. Nevertheless, the river has on its right side—first, the ruins of a large Buddhist town of early date; second, of an almost equally large town of later Buddhist times; and third, of a small Mohammedan village; while on the left or west side it once supported a Buddhist hamlet and a fair-sized Mohammedan village. The two larger Buddhist sites resemble those of Niya in relative age and location, but are of greater size and more separated, and the older town appears to have been the more populous. The larger Mohammedan village, a walled enclosure within which the houses are still standing, is much smaller than either Buddhist site, its houses numbering 150. Like the Buddhist towns on the lower Niya and Chira rivers, and the late Mohammedan sites of old Ponak and Dumuka, it appears to have been abandoned deliberately and of set purpose, for the houses and walls were left intact, and everything of value was carried away. Disregarding the two smaller sites, we thus have on the Endere river the ruins of three towns of different ages, which grew up one after the other, the later town in each case being smaller than its predecessor. To-day there is water enough to support a large town, but it cannot be used because of the salt. The uppermost ruins lie only 12 to 15 miles

further up-stream than the present shepherd hamlet, and the lowermost lie quite as far down-stream. Even if the difficulty due to the entrenchment of the river to a depth of 20 or 30 feet could be overcome, and the water could again be brought to the ancient sites, it would be too saline to support such large and permanent towns. If, however, the water-supply was once enough greater so that surface water reached the lower parts of the river three or four months each year instead of only one, the difficulty would be largely obviated, and the conditions would be like those of modern Niya, the fields would gradually become saline, but it would be many years before they would have to be abandoned. On any other supposition the location of the towns and their successive abandonment seem inexplicable.

Still further to the east, 200 miles from Endere, the Vash Sheri river rushes swiftly down from the mountains, and, after losing most of its volume in the Piedmont gravels, supports the thirty people of Vash Sheri. During the months of June, July, and August, the melting snow on the mountains—30 to 40 miles away—increases the river's volume enormously. Hearing of this large amount of water wasted among reed-beds, a considerable number of people have come to Vash Sheri during the thirty years since it was settled, but most have gone away after a year or two. In summer they had more than enough water for their fields, but during the planting season of April and May the supply often ran short. Under the present conditions of climate and irrigation, a population of thirty or forty is all that the river can support. Yet in ancient times the number of people must have been many times as great. Formerly, the river followed a more westerly course. At the end of the old channel, and at the same distance as the modern hamlet from the mountains, the ruins of a Buddhist town cover an area at least $2\frac{1}{2}$ miles long by 1 wide. Here, as at Niya, the ruins consist of two parts. The older village covered the whole area. Its houses have completely disappeared; but if it were settled as densely as the abundant pottery indicates, or as densely as the modern villages, its population must have numbered five hundred or more. The later village, or the later part of the original village, as the case may be, occupied only the upper portions of the ruins. Traces, sometimes very faint, of sixteen houses can be seen, and some must certainly have disappeared or escaped notice. It is safe to say that near the time of its abandonment the village must have had a population of a hundred souls—three times as many as the present hamlet—and that earlier it must have had far more: so large a number of people could not be supported to-day without a radical change in the system of irrigation. Fortunately, the river changed to its new course as soon as the abandonment of the village allowed the rude dam of small boulders at the head of the old channel to fall into decay. Accordingly, the irrigation works have not been subjected to the destructive influence of floods,

and are still almost intact. The difficulty of keeping the river in its old bed may have been the immediate cause of the abandonment of the village, but it had nothing to do with the sufficiency of the water-supply of the past as compared with that of the present. The latter depends upon the character and width of the river-bed, which are essentially the same in both cases, the old channel being the wider, if anything, and upon the nature of the irrigation system, which, again, was precisely the same in the past as it is to-day. Then, as now, the innumerable minor channels into which the river divides were simply dammed with banks of gravel dug up close at hand. Thus all the water was gathered in a single larger channel on one side of the mile-wide flood-plain, and was led off into canals, mere ditches dug in gravel or sandy clay, as the case might be. If the river should again be turned into the old canals, the available supply of water at the ruins would apparently be essentially the same as that at the village to-day.

A hundred miles east of Vash Sheri the Miran or Miyan river rises in typical fashion in the main snowy range of Kwen Lun, breaks through the front range in a deep gorge, traverses the Piedmont gravels in a terraced trench, and disappears during much of the year in a broad gravel flood-plain. Geographically Miran closely resembles Vash Sheri, and the reasoning applied to the latter holds good with increased emphasis for the former. Archæologically Miran is more important, for the ruins are not only far larger, but a new type of architecture is developed, the chief structures being elevated 10 or 20 feet on solid pedestals of sun-dried bricks. At present Miran is not permanently inhabited, though the fisherfolk of Abdal, on Lob Nor, 20 miles to the north, come in summer to cultivate the reedy fields, and, by using all the water available in spring, raise grain for about fifteen families. The fields can only be cultivated once in three years, for in a single season of irrigation a cake of clay 2 or 3 inches thick is deposited, a cake so stiff that crops cannot grow in it till it has been softened by two years of sun and rain. The natives think that the clay is gathered after the river begins to spread over the huge gravel flood-plain, 10 miles long and 1 or 2 wide. In reality the river is charged with fine clay when it leaves the mountains, where it is said to be equal to the river which supports the large village of Charklik. On reaching the flood-plain the water sinks rapidly into the coarse gravel, but as the current is swift, the fine clay is all borne along, until at Miran the river is literally a stream of mud.

Anciently, conditions must have been far different. The old Buddhist Miran was neither a hamlet, such as to-day might be located here, nor a village like old Vash Sheri, but a large and important town. It covered an area of at least 5 square miles, all of which, judging from the canals and pottery, and still more from the number and location of public and religious structures, must have been thickly populated. The

houses, being made of clay apparently, have disappeared, with two exceptions. Thirteen other structures remain, of which one is a fort, 400 feet square; one a lamasery, the outer walls of which are adorned with clay reliefs of Buddha; two are stupas, or shrines; and the other nine are solid rectangular masses of sun-dried brick, capped in most cases by the walls of what may, perhaps, have been monastic dwellings or Buddhist temples. These establishments appear to have been kept up after the rest of the town had become depopulated, or else were re-occupied after a period of abandonment, during which the fort fell into ruin, as is suggested by the flimsy repairs superposed upon the solid older structure.

Ancient Miran, in its prime, must have required a water-supply almost scores of times as large as that now available. It is reasonable to suppose that, being the most important place for hundreds of miles both from a religious and a military point of view, Miran had an irrigation system as good as the country afforded. The water at first came from an old river-channel east of the town, and later, apparently, from the present channel on the west. The dams and canals are preserved just as at Vash Sheri, and do not differ from those of to-day. The main older dam is composed of tamarisks and small boulders thrown loosely together; and there is said to be another, which I could not find, composed of boulders alone. The canals are either simple ditches, or are raised a few feet on banks; but in every case the material is that which happened to lie close at hand. On the upper Miran river there are no inhabitants, and no opportunity for the diversion of part of the water. The present supply, sufficient for fifteen or twenty families, is all that the river is capable of furnishing under the system of irrigation which prevails now, and prevailed in Buddhist times a millennium or more ago. If, however, the rainfall were increased, say, a third, the amount of water reaching Miran would be multiplied vastly. Being confined to a single channel, the water would suffer scarcely more loss from evaporation and from sinking into the ground than it now does, and all the extra supply would be available at Miran. The difficulty from the excessive amount of sediment would vanish, for though the absolute quantity might conceivably be more than now, it would be diluted with a far greater amount of water, and spread over a much larger area. The hard cake would be reduced from 2 or 3 inches to perhaps a quarter of an inch, not enough to interfere with cultivation. Miran, even more than the other ruins, seems to verify the hypothesis of a change of climate during the historic era.

The ruins of Miran, Vash Sheri, Endere, and Niya are typical of many others. Charklik and Cherchen belong to the same class as Miran and Vash Sheri, the old towns having been located at nearly the same place as the new, and having covered a larger area. This is especially the case at Cherchen, where Lellik, the southern and

apparently older ancient site, covered an area three times as large as the modern town, and the northern later site may have been as large. Neither Charklik nor Cherchen is conclusive, however, for the size of the ruins at the former cannot be determined, and the whole water-supply at the latter is not now utilized. Yartungaz resembles Endere, but the river is much more saline. Accordingly, as might be expected, the ruins are old and rather small, and lie at the highest possible point, like most of the modern oases. The remaining ruins, lying west of Niya, belong to the same type as the latter. Rawak, Dandan-Uilik, and Uzun Tetti were successive towns on what appears to have been the ancient extension of the Chira river, aided more or less by the smaller streams to the east. The pottery-strewn site of Lachinata lies beyond the end of the Gulakhma river; the Buddhist ruins of Payet Beg and Khadaluck and the recently abandoned towns of old Dumuka and old Ponak indicate the former greater length of the Dumuka and Ponak rivers, and an unnamed site in the sand shows that the Karakir stream once extended 15 miles beyond its present limit.

On the northern border of the Tarim basin there is less opportunity for the occurrence of ruins of the kind described above, for most of the streams are either very small, or else, uniting in the highlands, issue from behind the mountains as large rivers which join the Tarim, and will be considered later. At Ying-pen, however, north-west of Lop-Nor, the ruins of a small fort and village described by Hedin are now waterless. I followed the old canal northward for over 3 miles to its head, and found that it was a simple ditch with two small ponds or reservoirs, into which the water was turned from the little Shindi brook, the largest stream in the Kuruk Tagh, or "Dry mountains." To-day no water reaches the ruins during the greater part of the year, and the place cannot be inhabited, yet formerly the water-supply sufficed to support a small village.

Similar instances of ancient towns located where there is now no sufficient water-supply are described by Stein as far west as Kashgar; and I found others as far north as the depression of Turfan. Eastward beyond the end of Lob Nor, on the course which the united Bulundsir and Tan-ho rivers once followed on their way to the lake, two other ruined sites of the same sort are described by the natives. The Chinese of Dung Khan (Sa Chau), higher up on the Tan Ho, say that the ruins were abandoned by their ancestors long ago because the water of the rivers would no longer reach them.

In the case of the rivers of the Tarim system, the evidence of desiccation is less clear than among those of the withering type, for the streams are so large that they still support extensive oases and terminate at a fixed point in Lob Nor. Still, the increasing salinity of the lower Tarim, and the decreasing size of the terminal lake, seem to show

that the rivers of this group, like those of the other, have suffered desiccation. The region along the lower Tarim or Yarkand river for 400 miles, and along its parallel tributary, the Konche, for 250 miles above the mouth of the united streams in Lob Nor, is to-day practically uninhabited. The scattered little settlement of Tikkenlik is the only real village, and almost the only place where agriculture of any sort is practised; and even its five hundred inhabitants could not subsist, so they say, if it were not for their flocks and for the fish which they eat in summer with young reeds and rushes. The great difficulty is salinity in both soil and water. Indian corn, one of the great staples of Chinese Turkestan, will scarcely grow at all, and is replaced by millet. Wheat fares better, but only the first year. If a field is cultivated several years in succession, the crops rapidly dwindle just as at Endere and Yartungaz.

The same difficulty prevails all along the lower course of the Tarim and Konche rivers, and several recent attempts of the Chinese to found towns have proved abortive. About 1889 some colonists settled at Jan Kul, 30 miles west-north-west of Tikkenlik, on the Tarim. Next year the population increased to over 2000, and Jan Kul, as the people say, "became a town;" that is, a bazaar was established, and an "amban," or local governor, was installed. But the fields quickly became saline, and after two years, in 1892, the place was abandoned, most of the settlers returning whence they came. Meanwhile, however, in 1891, about 1000 people had come from Turfan to Dural, 8 miles south of Tikkenlik, and had begun to raise wheat. Accordingly a large fort was built there, and in 1893 the amban of Jan Kul was removed to Dural, which in turn "became a town." For three years the population increased, but by 1897 the soil had become so salt and the crops so poor that the colonists began to move away. In 1898 over 2000 rebellious Dungans or Mohammedan Chinese were induced, or forced, to come from Shi-ning, 800 miles to the east, and settle at Dural, but the land and water were so bad that in 1900 they migrated 90 miles north-west to Karakum, on the Konche, another site which had just been opened. Thereupon, in 1901, the amban was removed to Karakum, and in 1904 the last of the people of Dural came to Tikkenlik. Karakum became even larger than its predecessor, and from 1901 to 1903 had a population of nearly 5000, but the salt was as bad as elsewhere, and in 1904 it too was abandoned, though the amban and forty or fifty people still remain. Jan Kul, Dural, Karakum, and Tikkenlik represent four abortive attempts during sixteen years to utilize the water of the lower Tarim and Konche rivers for irrigation. Tikkenlik, being but three or four years old, still survives, but its people are moving away or else are abandoning agriculture and betaking themselves to sheep-raising and fishing, the means of livelihood of the former hamlet before the attempt to establish a town.

Turning now to the past, we find a wholly different state of affairs. In Buddhist times the Tarim and Konche rivers were deflected eastward in whole or in part between Karakum and Tikkenlik, and flowed to the ancient ruins of Lulan, discovered by Hedin. In approaching Lulan from the north-east, and in leaving toward the north-west, I rode 15 miles each way through a region where houses, pottery, and other evidences of human occupation show that the whole area was once thickly settled by an agricultural population. Farther west, on again entering the broad zone of dead vegetation which accompanies the old river-courses, I found pottery, beads, slag, and bits of iron, for a distance of nearly 40 miles, and there was a little ancient pottery in a strip of dead vegetation between two arms of the Konche only 25 miles east of Tikkenlik. It looks as though in ancient times an area 100 miles east and west, by 10 or 15 miles north and south, was thickly dotted with villages irrigated by the Tarim and Konche rivers. Even if the present water-supply would suffice for so large an area, a densely populated, flourishing district like the Lulan of history would be impossible because of the water's salinity. Here, as in so many other cases, the phenomena are easily explicable if the rivers have decreased in size.

The lake of Lob Nor agrees with the rivers, for it shows signs of having been larger at no very distant date. In this article it is not possible to consider the controverted history of the "Great Salt Lake," as the ancient Chinese called it. It must suffice to say that in travelling around it, and crossing the unexplored salt desert at its eastern end, the presence of five, or possibly six, old shore-lines at altitudes of from 12 to 600 feet above the present level, and of a thick series of lacustrine deposits, indicates that the lake has passed through a succession of epochs of expansion and contraction corresponding to those of the lake of Sistan in Eastern Persia, and less closely of Great Salt lake in North America, and to the epochs of the Glacial Period all over the world. The freshness of the dry lake-bed and bluffs, the distribution of vegetation, the presence of an ancient road, now unused and unknown, which makes a long *détour* around a bay of the old lake-bed instead of crossing it as the modern road does, and the well-known fact that the present lake or swamp has diminished in size during the past century, seem to indicate that the last notable expansion of the lake took place, or at least had not yet passed away, when historic man occupied the surrounding region.

The rivers which wither in the desert, together with those which join the Tarim and terminate in Lob Nor, drain most of the mountains around the Tarim basin, but there is one part so extremely dry that there are practically no running streams whatever, only a few scattered springs, mostly salt. This inhospitable district, as large as Great Britain, lies between Lob Nor on the south, Bagrash Kul on the

west, and Turfan on the north, and stretches eastward 400 or 500 miles toward the desert of Gobi. It is a desolate region of naked mountains half buried in plains of gravel, and is well named the "Dry mountains" ("Kuruk Tagh") on the south, and the "Desert mountains" ("Chol Tagh") on the north. It is so little known that the best I can do is to quote what was said by my guide, a remarkably intelligent camel-hunter of Kuzzil Singer, the only inhabited place, who knows every spring and mountain for 100 miles in every direction. I asked him whether there was more or less water now than in the past, or just the same. In reply he told of the drought during the last four or five years which every one speaks of, and then went on, "And long, long ago, in the days of which neither my grandfathers nor their grandfathers ever heard, there must have been much more water. In the high mountains there are many places where little stone shepherd's houses, with the roofs all fallen in, stand in valleys where nobody has ever known of there being any water. The nearest water is sometimes 5 or 10 miles away. Surely no one would have built houses and kept flocks and herds in those places unless there had been water. How many such houses have I seen? Oh, many; I never counted, but the mountains are full of them. In other places, away from the higher mountains, one often finds salty deposits and a few reeds where once there must have been springs, and on every side there are old paths coming in where once the wild camels and antelopes used to come regularly to drink. Now, as there is no water and only a very few reeds, scarcely two or three animals come in a year. There were men here then, for near almost all of the dry springs there are old shelters of rocks and pieces of tamarisk, just such as we make now when we lie in wait for game. I never talked to any one about this before, and I do not know whether I am right, but I have seen these things when I have been hunting, and," as the Turki idiom puts it, "that is what I know in my stomach." My own limited observation agrees with that of the camel-hunter. Moreover, I found traces of ancient roads and of villages where there is now no water, and the basin of the Turfan, near by to the north, is full of evidences of an historic decrease in the water-supply.

The phenomena of rivers, large and small, of springs, lakes, ruins, and vegetation, all seem to point to a gradual desiccation of Chinese Turkestan for nearly 1500 miles east and west, and 500 north and south. The records of antiquity indicate that the Caspian and Aral seas were once more extensive than now, and presumably that the tributary rivers were much larger. Transcaspia, Eastern Persia, and the neighbouring regions appear to have been subject to a desiccation similar to that of Turkestan, and indicated by similar phenomena. Thus all the more arid part of Asia, from the Caspian sea eastward for over 2500 miles, appears to have been subject to a climatic

change whereby it has been growing less and less habitable for the last two or three thousand years. Such a change, embracing Persia, Baluchistan, Afghanistan, Russian Turkestan, and Chinese Turkestan, and probably an even larger area, and converting thousands of square miles of habitable country into desert, can hardly fail to have had some effect upon human distribution and history. In Chinese Turkestan part, at least, of the ancient towns described above appear to have been abandoned deliberately, presumably because the water-supply became limited. Movements of the same sort are to-day taking place on a small scale all over the arid parts of Asia; as, for example, in the cases already cited of the inhabitants of Dumuka and other villages who moved in a body to a new location, or of the Dungans and people from Turfan, who wandered here and there along the lower Tarim. In 1904, 500 Kossack nomads, with their flocks and herds, came to Lob Nor, and would have settled among the reeds of the lower Cherchen river if Chinese soldiers had not driven them out with bloodshed. The nomads had come from the Altai mountains, where pasture had become too scanty either because of increasing drought or increasing population, or more probably both. Such movements only need to be magnified to cause invasions like those of the Dark Ages. That they were magnified in Turkestan when the Buddhist towns were abandoned appears highly probable. The abandonment took place in the early centuries of the Christian era, and for most of the time from that day to this the whole country from Keriya eastward for 600 miles, almost to China Proper, remained practically uninhabited, even more so than to-day. Not only the inhabitants of the towns disappeared, but also the shepherd tribes among the mountains, who, judging from names, traditions, and ancient roads and dwellings, were formerly numerous, and who would feel the pinch of aridity more quickly and keenly than the townspeople. Part of the population may have been killed in war, or have died in the epidemics which rage when a country is over-populated, but the rest must have migrated. If, though only in bands of a few thousands, they invaded regions already well populated, where the means of livelihood were growing less because of desiccation, distress and wars would ensue, and the only relief would lie in further and greater migrations. And thus, all Central Asia being under the same ever-increasing stress, a succession of dry years, or a change such as has taken place in Chinese Turkestan since 1900 from an increasing to a decreasing quantity of water in the rivers, might cause migrations equal to the greatest recorded in history.

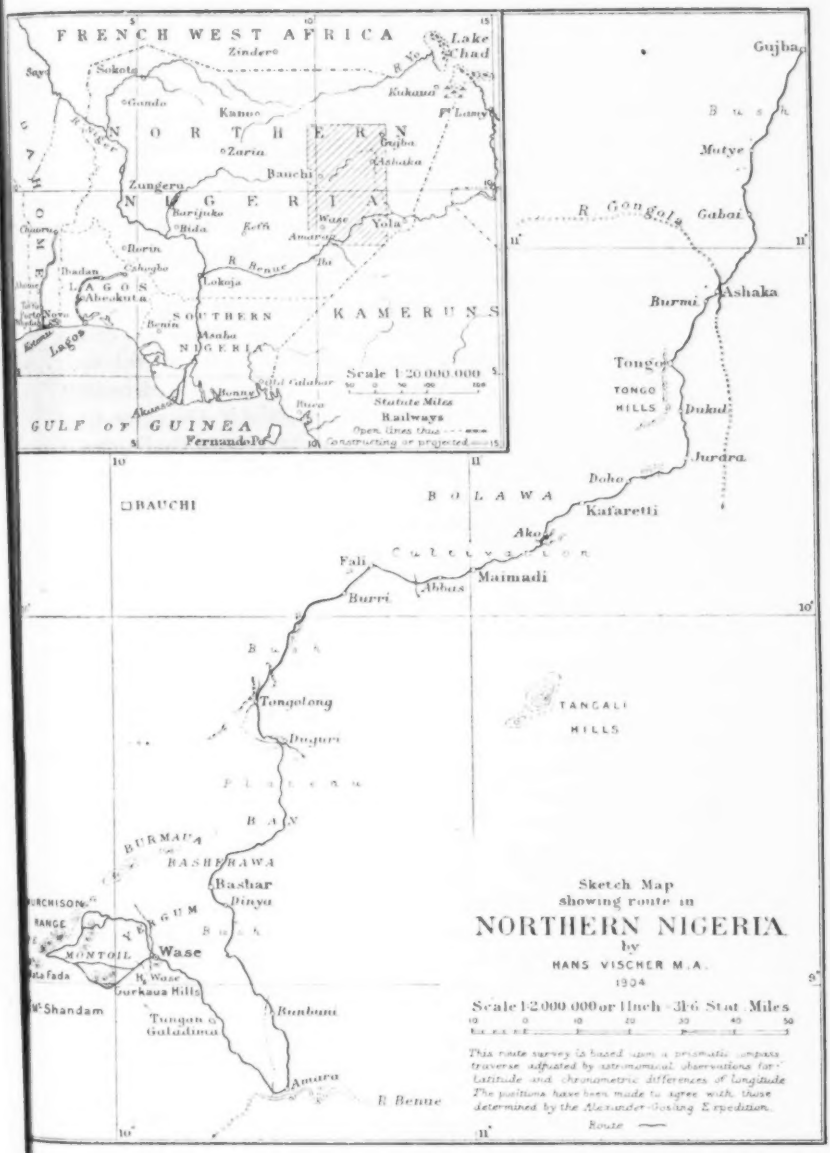
JOURNEYS IN NORTHERN NIGERIA.

By HANS VISCHER, M.A.

For a very long time the Niger and its tributaries successfully withstood all attempts at discovery at the hands of European geographers; individuals and whole expeditions alike were killed or turned back time after time by the climate or hostile native tribes, and many lives were paid for the ultimate discovery of that river system. The student of geography who travels along the Niger or the Benue, marking his day's journey on a fairly accurate map, cannot but feel that he is treading on sacred ground. The great struggle for the clearing up of the river-system, and the subsequent contest for possession of the country which led to the division on the map as we now know it, form an interesting chapter in the history of European enterprise in Africa.

The traveller in the Benue valley is struck with the enormous variety of the apparently wholly different tribes that he finds settled on both sides of the river. Fulanis, Beriberis, Hausas, Jikums, and endless pagan tribes, all are crowded together along the river valley. The great river, with the hill ranges running parallel on both sides, formed a natural barrier to the movement of nations, thrown from their original abode in the central Sudan by the incoming hosts from the north-east, or the tribes fleeing from some mighty neighbour or a raiding chief. Thus it is that we cannot trace local history of the tribes connected in the Benue valley to any extent. We know, however, that the mild-looking Jikums once warred successfully with Kano and Bornu, and received tribute from all the countries around in the old capital Kororofa, a little south of the river, and that the empires of Bornu and Sokoto in turn largely influenced the composition of tribes along the Benue. The sultans of Bornu periodically raided the countries to the west of Chad, driving down the tribes living along the borders of their empire. These would move down to the hills, driving off in their turn the people already there. So we have along the river nearly every tribe claiming to have come down from the north—such as the Ankwes, the Montoils, the Yergums, the Burmawas, the Jemuris, and the Bashamas. Besides these, the word Beriberi, joined on to a local name, denotes a settlement of Beriberis, or Kanuris, who have come down quite lately from Bornu, and whose fathers or grandfathers still spoke the Kanuri language.

Of the Fulanis on the river, we know that in the time of Bello Emir of Sokoto Modi Mohammad, a Fulani of the Kiri tribe came down into the valley with his fanatic horsemen to wage the Jehad against the pagans. He had a banner from the great Bello, the son of Othman dan Fodio, and was the brother of Bubaero, the chief of Gombe. He defeated the heathen Jemuri, and on the site of their ancient settlement built his own town, which he called Muri. Hammarua, who received the


FRENCH WEST AFRICA
Lake Chad
Zinder
Sokoto
Sayé
Gando
Kano
Kukawa
Ft Lamy
NORTHERN NIGERIA
Zaria
Gujba
Ashaka
Zungeru
Bauchi
Burijuko
Wase
Yola
Amarawa
Rida
Keffi
Ilorin
Benue
Ibi
Lokoja
Ibadan
Abeokuta
LAGOS
SOUTHERN NIGERIA
KAMERUNS
Benin
Asaba
Lagos
Old Calabar
Akassa
Bonny
Bight of Biafra
GULF OF GUINEA
Fernando Po
Scale 1:20,000,000
Statute Miles
Railways
Open lines thus
Constructing or projected
Gujba
Mutye
R. Gongola
Gabai
Burmi
Ashaka
Tongo
TONGO HILLS
Dukul
Jurara
Daka
Kafaretti
BAUCHI
BOLAWA
Aka
Fali
Maimadi
Abbas
Burri
Tongolong
Duguri
TANGALI HILLS
PLATEAU
BAN
BURMAWA
BASHERAWA
Bashar
Pinya
GUM
Wase
MONTOIL
H. Wase
Gurkawa Hills
Tungan Galadima
Bunbuni
Amura
R. Benue
Sketch Map
showing route in
NORTHERN NIGERIA
by
HANS VISCHER M.A.
1904
Scale 1:2,000,000 or 1 inch = 31·6 Stat. Miles
This route survey is based upon a prismatic compass traverse adjusted by astronomical observations for latitude and chronometric differences of longitude. The positions have been made to agree with those determined by the Alexander-Boring Expedition.
Route

Pleyad party in 1854, and Nya, the friend of Mizon, were both successors of this Modi Mohammad. After the conquest of Kona these Fulanis crossed the river and settled at Jalingo, where the present Emir Haman Mafendi now lives. Before this some of them had settled along the Tarabba river; but, broadly speaking, the Benue forms the southern limit of Mohammedan influence. These Fulanis had for a long time worried the Jikums, and at last, compelling them to abandon their capital Kororofa, had broken their power.

Quite different from these Fulanis are those cattle-breeding nomads, who are frequently met with along the Benue. They have never appeared as warriors, but as peaceful cowherds; coming from no one knows where, they passed in and out amongst the native tribes, going where they thought they would find good pasture for their cattle, inoffensive and unmolested. They did not mix with the people of the land as did their Mohammedan cousins, and thus they preserved their light skin and their Asiatic features. They never became Mohammedans. Since Andrée Brue, in 1697, encountered his Fulanis 100 miles from Timbuktu, the origin of this strange tribe has ever puzzled the European. Successively they were connected with Egypt, Carthage, Morocco, the Caucasus, and Persia.

There are several routes from the Benue to the northern territory. The more important of these are: the one leaving at Loko, and passing through Keffi to Zaria and Kano; another from Ibi to Bauchi; and a third from Yola to Bornu. It was by this middle one that I left the Benue valley for the north. The first important place that I arrived at in 1904 was Wase. This pretty walled town is situated on a ridge, and close behind it stands an enormous basalt rock, evidently the denuded stump of an ancient volcano. In shape and aspect that mighty block resembles the famous Bear Lodge in the Black Hills of Dakota. On its top thousands of birds find a resting-place, and their deposits in the dry season give it a look of a snow-covered mountain summit. Being almost inaccessible, it has given rise to many weird legends, which the Wase host retails with much relish to the new-comer. The natives call the rock Goran Dusan, *i.e.* the Kolanut-stone, measuring over 1000 feet from the base; it is visible for miles, and known to every traveller in the country, and from it the local chief takes its name of Sarlkin-dutsi, the Rock King. To the westward, at a distance of a little over 10 miles, the ragged hills of the Murchison range present a beautiful sight. The Wase river flows through the intervening plain; along its banks stretches of green pasture vary with cultivated fields, and great herds of cattle grazing everywhere give the whole an extremely pleasing aspect. The town, with its well-built houses now in ruins, its date palms and crenelated wall, has seen better days, and the local history is typical of the fitful political changes that kept the country in a perpetual state of unrest, making it a difficult field for peaceful administration.

With the advent of a Western government, a stop was put to all these local enterprises, but no power on earth could freeze this seething mass into even shape in a moment. The pagan for some time to come would look with hatred and suspicion at the Fulani chief, and the latter would find it difficult to see the native Kaffir anything else but his rightful prize. It cannot surprise any one when the savage amongst the hills, forgetting that all things have changed, lets fly an arrow at the passing caravan from sheer force of habit. The man who got the last knock not unnaturally longs to be able to hit back.

Originally there was a fairly large settlement of Jikums at the foot of Wase rock. Then when Yakoba had built Bauchi town to the north and had become powerful, his followers came south and conquered the country towards Muri and to the Benue, driving away the Jikums, and causing the native pagan tribes to take refuge in the hills. After the fashion of the Fulanis, Yakoba gave Wase to one of his chief slaves. This giving away of large newly conquered districts had its obvious advantages, for the province was ensured against falling back; the possession of large lands stimulated the servants of the chief, while it provided the necessary food and material for the upkeep of the army; moreover, the slave leaders were kept away at a safe distance from the court. Similar to our old feudal barons, they held the land from the king, to whom they paid an annual tribute, and had to keep up an army always ready to start at the command of the king.

In connection with the present dilapidated state of the town and the proverbially bad character of the Wase people, an old slave of the late Emir of Sokoto told me the following tale: "When the Emin-el-Musselmi sent his messengers round to all the various towns of the provinces, one of them arrived one evening at the town gate of Wase just as the sun went down beyond the blue hills of the west, and Salla was called from the mosques. In those days the town was crowded with people. The women wore beautiful silver bracelets and rich clothes, even the poorest of the men had his horse, and as to the horses and cattle of the chief and his slaves they could not be counted. There was no lack of grain and fruit of every kind. All was abundance and happiness. The drums and dances were kept going until the town woke up in the morning. Then the king and the chief men sent for the Sokoto messenger, and gave him one bowl full of corn; that was their contribution to the mosque at Sokoto. There on that small hill north of the town the man from Sokoto stood. He was a holy man, and he cursed the town, and he cursed the men in it. From that day the Wase men eat without ever stilling their hunger, the sun dries up their seed, and the rain beats down their houses, and where will you ever see a well-fed horse or a beautiful woman in Wase town to-day?"

When the horsemen from Bauchi originally came down, they found

living alongside of the Jikums the pagan tribe of the Yergums. These people now live in the mountains of the Murchison range just opposite Wase, and in the plain between the Wase river and the hills. The Yergums say that they did not take to the mountains till they were driven there, and that originally they also had come down from the north. As far as I can judge, after a stay with them of only a few months, I believe, from their features and their language, that they belong to the same stock as their neighbours the Montoil, the Ankwes, the Angoss, the Burmawa, and the Gatali, all found along the hills running parallel to the river. Most of these tribes are still cannibals, but nowhere did I find that this was connected with any religious ceremony. As an old Montoil chief informed me, man's flesh is eaten because "it is extremely tasty, far sweeter than goat or sheep." Fear of the various spirits and their propitiation seem to constitute their religion. Under "Nan," the Yergums understand what the Red Indians call the great spirit. The blazing of the sun, the downpouring of rain, are his manifestations; he speaks in the thunder and in the howling of the wind. The idea of transmigration of the soul is not unknown to them. Accidentally one day I overheard a Yergum boy who had joined my boys as a donkey driver, saying, while looking at his tired ass, "May Nan never turn me into a donkey. I would rather become a dog than a jackass." Any one who deals with these pagans, and sees them in a natural state and not frightened, will notice that as a rule they strictly adhere to the truth. This being very unusual amongst the natives which I had seen before, I asked a young Yergum, who told me that no men with any sense ever willingly told an untruth. Though this characteristic is not uncommon amongst primitive races, it shows how much these pagan tribes have kept to themselves, for no one who has visited the Benue will assert that the native there would easily forget himself so far as to give a straight answer to a straight question. As regards the dress, the Yergums have simple tastes. The men wear a skin round the loins; the women a few bunches of fresh leaves stuck into a narrow belt, carried in front by the married women, and behind by the girls.

Around and behind the Yergums on the various hilltops are scattered other tribes, such as the Talus, the Pés, and the Gazums. While visiting the latter, I found right up to the mountain crest regular terraces, skilfully built of large granite boulders, and in several places where the path led over the steep rocks, regular steps had been cut, similar to those an Alpine guide carves in the ice. It will require a good deal of careful study to find out who were the original inhabitants. There are a number of natural caves, but in none of these could I find any signs of previous occupation.

Leaving Wase I followed the route through Bashar, a prettily situated and well-kept place. The natives are good farmers, and form

a close community, allowing no strangers to settle in the town. They claim to have come from Bornu.

The road then leads on to the north over the hill range to the high plateaus of Bauchi. The country is more wild and rugged, showing volcanic action; the plateaus of iron sandstone are intersected by deep cañons. The road leads through several of these, first at Duguri, where we have a regular valley with a little river and fertile fields on both sides.

Further on the road at Tongolong, the village lies in a regular chasm. The sheer precipices of rock which enclose the little settlement have formed a natural and effective defence against all intruders. The natives like informing one that they were never worried by the all-feared Fulanis, who, indeed, must have turned back for their horses' sake at the sight of these rocks. It was also the natural and safe position of their settlement which made them independent from their chief at Fali. They say that originally they had come down with the Fali people from Bornu, and their features, as well as their tribal marks, certainly seem to bear that out. I willingly consented to the wish of the venerable old headman, who asked me if his people could have their dance in the evening.

The high cliffs of the valley showed clearly in the bright moonlight, when the strains of a native band were heard coming from an adjacent village. Through the long guinea-corn stalks men and women came out like so many shadows from the various clusters of huts. The sound of the fiddles and the rattling of a calabash filled with pebbles came ever nearer, till the band with many followers emerged from the dark fields to the open space, where a broad sandy river-bed formed a natural playground. A merry crowd had now gathered, chattering and laughing and thoroughly enjoying itself after the way of the African. The musicians, three stout men and a woman, played in that typical way common to all primitive people, one fiddle leading with a slightly varying wailing tune, when the second fiddle took up the air, repeating it in lower notes, and the woman accompanied with a rhythmic swinging of her calabash. It is a weird, melancholy noise, naturally in a minor key, but full of ever-growing excitement. All the young people had now formed into two rings, the men inside, and round them an equal number of girls. They started walking round slowly in opposite directions. Then, as the music became faster, they quickened into a kind of two-step, the men dancing in and out around the girls, who kept moving the other way. Each time the boy faced the girl, he turned round, gave a little jump, and, smacking her outstretched hand, moved off to the next beauty, where the performance began again. All was done in time to the music, and the movements of the laughing youngsters could not have been better measured. Without reserve all abandoned themselves to the most thorough enjoyment, dancing and yelling as if

we had been acquainted for years. A little way off sat the matrons and the old men, watching and talking over what they had done in their younger days. Behind was the black bush, with here and there a higher palm tree coming out and showing in clear silhouette against the white rocks; while the stars moved slowly over the sky, and the great silver moon made it all look wonderful and uncanny. Quite unconsciously I recalled old familiar scenes, other music, other costumes, and a smaller room, and these naked savages were after all not so very different from the wise Westerners.

Forty miles' march in a north-eastern direction brought me to the town of Fali, lying well outside the hilly country, in that great undulated plain stretching from the foot of the Tangali mountains towards Bauchi and Gombe. About halfway on that road some deep wells, cut straight through hard rock, point to the existence of some ancient settlement. Some overgrown rubbish heaps or a dilapidated well, all that is left over of an ancient town or village, is a very common sight to a traveller in those parts. Even up to this day an unpleasant neighbour or a succession of bad crops is sufficient to cause a whole community to migrate to another place.

The traveller is struck at Fali with the size of the ruined compounds and buildings, where many remains of well-built arches and prettily painted columns point to the former wealth of the inhabitants. Some of that wealth they got from the salt-pans at Jebjeb, over the hills to the south, in the Muri province. Once a year all the powerful men went out to Jebjeb with their slaves, and returned again with the salt when the first tornados announced the rainy season, and it was time to prepare the fields for cultivation, in the same way as the Manga salt-pans are worked to-day by the Kanuris. But since the Sarikin-Bornu, the chief of Missau, came down for an expedition to the Benue, and took with him the king's son and all that was proud and powerful in the town, the good days of Fali have gone, for only a few returned. So runs the native story, and, if nothing else, it certainly gives a good explanation for the small number of people that populate the ruins of a once powerful town. The salt-pans at Jebjeb are scarcely used now, and of the great bridge on the Jebjeb road crossing the river east of Fali only some piles remain.

Fali and all the country around it belong to Bauchi, the great town to the north-west. The first European to visit Bauchi had been Vogel, in 1855, who visited the chief Yakoba in his camp on his way down to the Benue. In 1862 von Beurmann stayed there for a fortnight, after which he returned to Kuka; and in 1867 Rohlfs passed through on his way from Bornu to Keffi and the Benue. The history of the town as described by this traveller is extremely interesting, showing the fairly isolated instance of a heathen state founding a tributary state under Sokoto. At the end of the eighteenth century Yakoba, the

younger son of the Chief of Trum, a small negro state off the Gere, in the Yoli mountains, went to the court of Sokoto, where he accepted Islam, and spent several years in study of the sacred books. Shortly after his return home his father died, and, aided by the Sultan of Sokoto, who by then had taken the title of Ruler of the Faithful, he was able to oust his elder brothers and take the throne to himself. At the same time his master gave him the country south of Kano to the Benue, inhabited entirely by pagans, Hausas, Bolawas, and Bauchis. Amongst the latter, to whom he and his family belonged, Yakoba built a town, and called it Garon-Bauchi. Soon the town, by reason of its favourable position between Kuka, Adamawa, Nupe, and Kano, became a renowned trading centre. A wise law, which he established at first, namely, that none of his subjects, Mohammedan or pagan, should be sold into slavery, helped to make him a popular ruler. But the Fulani from Sokoto soon became the dominating party at court, oppressing the pagans. This led to civil war, which was, however, successfully suppressed. An attack from the powerful Bornu was met victoriously, and the kingdom of Bauchi was officially recognized by El-Kanemi. After forty years' reign, Yagoba died in 1847, and was followed by Brahima.

From Fali the Bornu road turns in an easterly direction, and marching along the high plateau through pleasant and open country, I passed various large villages, with extensive and well-cultivated guinea-corn fields. Four days' journey brought me to Kafaretti, the first Bolawa village. These Bolo negroes are one of the most important native tribes in the Bauchi country. The men are tall and broad, and do not, as a rule, shave their heads after the fashion of the Hausas and Kanuris. From what I could collect of their language, the vocabulary seems extensive, and they pronounce their words with a curious nasal sound. There are a good many roots in the Bolowa language that occur, in a slightly altered form, in Hausa. If the Hausas are, as most of the old travellers held (*vide* Denham, Clapperton, Barth, and Nachtigal), the result of the mixing of different negro tribes and some northern elements, their language certainly seems to point that way, for there is hardly a race in the Sudan now which has not contributed some words to the Hausa vocabulary. The Bolawas that Rohlfs met in the sixties were still uncivilized pagans. Those I have seen showed in their dress and their manners that they had accepted much from the surrounding Mohammedans. At Kafaretti the men wore the Hausa tobe, and the women the ordinary black cloths. Most of the latter have their hair done in the Fulani fashion, with strings of beads woven into it. A curious dance was performed by the old chief himself, who was dressed up in the most fantastic way, and seemed considerably embarrassed by his large state robes. Four fiddlers and two men with large fans accompanied him. Slowly gliding backwards and forwards, he arrived in front of me, and then, going back again, repeated this several times.

Finally he was escorted home by all the elder men present. The great mass of villagers solemnly watched this performance.

To the west of this high plateau there are several small ranges of hills, which separate it from the Gongola valley. On entering these hills, I came to the picturesque heathen village of Doho. With its well-kept high walls, intersected by a number of tower-like structures, over which one catches a glimpse of the huts on the other side, the place looks like some mediæval town with wall and battlement. All is built of a light yellow clay, showing off prettily against the dark background of the wooded hills and the light blue contours of the mountain range to the south. The compounds inside the walls, remarkably clean and well kept, consist of a number of huts and high conical-shaped granaries, all connected by a wall enclosing a courtyard, in which the women of the house grind the corn. One of these granaries I measured 20 feet high. When the owner wants some of his grain, he sends up a boy, who climbs to the top with a wooden ladder, and, having removed the little grass cap from the aperture, lets himself down by a rope, and so brings out the required bundle of guinea-corn. A great deal of iron is found near Doho, and smelted by the natives in the place. I saw here, for the first time, some Tangali pagans, who, owing to a bad harvest, had been driven down from their mountains, which were showing in a faint outline on the southern horizon. What Vogel (*Zeitschrift für Erdkunde*, vol. 6, Heft 5) wrote from Bauchi is the most authentic information we possess of this wild tribe: "While at Bauchi I made the acquaintance of cannibals, with whom even the Mohammedan natives had scarcely any intercourse. They are all called by the country people Nyamnyams, a collective name, similar to our term of man-eater, as Nyam means in their language 'man.' The wisest and most important tribe amongst them are the Tangali, who inhabit the mountain range to the south, known by the wonderful peak towering high over the plain. These people have up to now kept themselves independent, and are only frightened from time to time by raids of the Gombe chief, who lives five days away from them. They rarely descend to the plain to buy iron implements for their farms, and it gave me some trouble to enter into communications with them, for at first they ran away at the sight of me, like the heathen on the Mandara hills. Some beads and other small presents at last quieted them, and I found the people good-natured, talkative, and extremely grateful for my presents. It is untrue that they eat their sick. By chance I saw two people sick in their village, and found that they were being nursed tenderly. When they died, their relations broke out in the usual wailing, which lasted all night. But they eat all their enemies fallen in fight. The breast was given to the chief, and the head, as the worst part, to the women, while the soft parts were dried in the sun and ground into powder, to be mixed with the cooked food." So far Vogel.

Richard Lander was informed that the mountains south of Kano, towards the sea, were all inhabited by the wild Nyamnyams, and again we meet that name in the descriptions of Schweinfurth's travels through the heart of Africa. The occurrence of this name of a like meaning in the different parts of Africa points to a language common to some primitive race, which must have been that of the original inhabitants of the country, or that in these hill pagans we have fairly sure descendants of the old Africans. The Tangalis that I saw were very black and ungainly built, with coarse negro features. They had no tribal marks, and wore absolutely no clothes.

Doho was the last heathen village that I saw before crossing the Gongola into Bornu. To the north of Doho the country is inhabited by the Gombe Fulanis. Passing through Dukul, Tongo, and over the ruins of Burmi, I came to Ashaka, and, bidding farewell to that country where such an interesting chapter of African history has been written, crossed over the Gongala river into the land of the merry Kanuri.

TWENTY-FIVE YEARS' GEOGRAPHICAL PROGRESS.*

By the Right Hon. Sir GEORGE TAUBMAN GOLDIE, K.C.M.G.,
President R.G.S.

It is just a quarter of a century since the British Association held its last meeting in this ancient city of York, and celebrated the jubilee of its foundation, so that from the moment of accepting the invitation to preside over this Section it was clear to my mind that the most appropriate subject for my address would be the progress of geography between that jubilee and what I believe would be called in other spheres our Diamond Jubilee. For although the immediate concern of geographers is with the Earth's surface, yet we cannot avoid sharing with the rest of our race the religious observance of astronomical periods and the tendency to regard certain numbers of such periods as having a peculiar value. Geographers, indeed, might be excused some tendency to this human weakness, as they are entirely dependent on astronomical methods and on an elaborate use of numbers for the primary necessity of ascertaining where they are on that surface which it is their business to examine and describe.

I do not propose in this address to deal only, or even chiefly, with the progress of exploration since our jubilee meeting in York, for although that progress has been remarkable, its effects are probably less far-reaching than the growth during the same period of the scientific treatment of geography; while both of these advances, taken together, are, to my mind, of less importance to our country—and we are, after all, a "British" Association—than the spread of the geographical spirit amongst our people, on the main cause of which I shall say a few words. Let me deal, then, with these matters in turn, bearing in mind, however, that the two latter subjects—the growth of scientific method and what I may term the democratization of geography—are so interwoven as to make it impossible to separate them altogether.

First, then, as to the advance of exploration since 1881. In that section of the

* Address to the Geological Section at the York meeting of the British Association for the Advancement of Science, by the Right Hon. Sir George Taubman Goldie, K.C.M.G., LL.D., F.R.S., President of the Section.

Arctic Regions in which the Nares and the Greely expeditions had done their work considerable progress has been made, mainly by Lieut. Peary, who carried the investigation of the coast of Greenland further north and east than had been the case before, while his contributions to our knowledge of the inland ice are of much value. The explorations of Captain Sverdrup among the lands lying north of America, and the not less important expeditions of Nordenskjöld and Nansen across the centre of Greenland, have added much to our knowledge, not only of the physical geography, but also of the geology, biology, and ice conditions of a land which, though lying to a large extent outside the Arctic circle, is essentially Arctic in character. Another expedition, under Captain Amundsen, is now completing its work, which has extended over about three years, around the north magnetic pole. Both English and Swedish expeditions have greatly improved our knowledge of the islands of Spitsbergen, while Jackson, Nansen, and others have enabled us to lay down with something approaching to accuracy the archipelago of Franz Josef Land. But perhaps the largest addition to our information about the north polar region during these twenty-five years has been through the ever-memorable expedition of Dr. Nansen, during which he reached within four degrees of the pole, obtained soundings down to 2000 fathoms, and collected a vast amount of meteorological, physical, and biological information, which has enabled him to work out, to a large extent, the probable conditions which prevail around the pole itself.

Let us pass now to the other end of the Earth—to the great continent which, as now appears beyond doubt, surrounds the southern pole. Here also very considerable progress has been made during the last twenty-five years. For a long period after the time of Ross, over sixty years ago, only spasmodic efforts had been made to continue the work of south polar exploration. But in recent years numerous national expeditions—Belgian, German, Swedish, and British—have pursued this work, producing a mass of data in geology, physics, meteorology, and biology which should throw a flood of light both on the present conditions and on the history of this dead continent. Perhaps, as the successor in the presidential chair of the Royal Geographical Society to that great geographer, Sir Clements Markham, a Yorkshireman, I may be allowed to dwell especially on the splendid and varied work of the National Antarctic Expedition under Captain Scott, which not only carried our knowledge of the Antarctic continent about 5° further south than the limits of exploration previously reached, but also collected a vast amount of scientific information.

And now, leaving the polar regions, let me try to recall the position of exploration of the African continent in 1881. Stanley had only recently completed that history-making journey across Africa, by which he traced on the map the last great line in the framework of the continent, the river Congo; and so accurate were his observations that, notwithstanding the vast number of later explorers, the course of the river laid down by him has practically remained unaltered. But a glance at a map of Africa of 1881 reminds us that enormous blanks existed, almost from the tropic of Capricorn to the upper bend of the Niger, in the centre and west of the continent; that the region between the equator and the Gulf of Aden was almost unknown; that our knowledge of the great lake region of Central Africa, as also of the eastern and western tributaries of the upper Nile, was most imperfect. Little had been done for the Central Sudan states since the days of Barth, and only very vague notions existed as to the real character of the Sahara. Since 1881, through the efforts of Stanley himself and of a host of Belgian, French, and British explorers, the map of the whole Congo basin has been crowded with rivers, defined with a fair approach to accuracy, while the hypothetical lakes of the past have evaporated. In the southern quarter of the continent, all the region from the northern limit of Cape Colony up to the Congo watershed and Lake Tanganyika has been to a large extent

mapped in a provisional way and all the main features laid down. The work of exploration in the eastern regions of Africa has been no less complete. Stanley, on his expedition for the relief of Emin Pasha, discovered the important range of Ruwenzori, and laid down with some precision the outlines of Lake Albert Edward; while British and German explorers have made very fully known those remote feeders of the Nile which supply the Victoria Nyanza, and have contributed largely to our knowledge of the great Rift valleys and the lakes which occupy them. Joseph Thomson, the original pioneer from the east coast through Masailand towards Uganda, has been followed by many others, so that the map of all this region is thickly studded with new features; while the Anglo-German Boundary Surveys have been able to lay down a trigonometrical basis for a complete and trustworthy map of the whole region. Somaliland, the outlying parts of Abyssinia, Lake Rudolf, the rivers that run into it, and the rivers that run from the south-east into the Sobat and the Nile—all these have been explored and laid down with wonderful fulness since the Association last met in York; while, after the breaking down of the barrier of Mahdism, the advance in our knowledge of the Egyptian Sudan became almost too rapid to record. Nor has the progress of exploration in Western Africa been less remarkable. Through the energy of the officials of the Chartered Royal Niger Company, of Sir Frederick Lugard and his staff, of Binger, Monteil, and a host of other French as well as German explorers, great blanks have been filled in, and mapping of the most detailed character in many districts has been rendered possible. Our knowledge of Lake Chad and of its present and its probable past has been greatly extended, and many problems have been suggested which will provide ample work for the geographer and the geologist. The Sahara has been crossed and recrossed in many directions during recent years, especially by French explorers, with the result that we have been compelled to revise the prevailing impression of the great desert, which is by no means the featureless waste which it used to be considered. Taking the continent of Africa as a whole, its map has been thickly covered with a network of features, and, so far as cartography is concerned, all that remains to be done is to fill in the meshes of that network with local details and to give precision to our maps by careful triangulation.

I have dealt at some length with exploratory work in Africa, because it is the continent of which we knew least in 1881, and our knowledge of which has made the greatest strides since then; but the contemporaneous advance of our acquaintance with the topographical and physical conditions of other portions of the lithosphere has been very remarkable. A host of explorers, of whom I will only mention Younghusband, Littledale, Bower, Sven Hedin, and Huntington, have crossed the centre of Asia in various directions. During the same period the topographical survey of India has been brought to completion, while Indian officers and others have carried geographical investigations far beyond the limits of our great dependency, and have made much progress in the mapping of Baluchistan and Persia. The recent Tibet expedition practically settled the question of the sources of the Brahmaputra, and laid down its central and upper course. I do not know whether we should regret that they were not able to fill in the long gap in the lower course of that river, for we shall still enjoy the pleasures of hope of solving this interesting problem, which, with some equally unsolved problems in other parts of the globe, reminds us that explorers need not yet sigh, like Alexander, for other worlds to conquer. Numerous travellers have crossed China in all directions, and have done much for its accurate mapping, as have also the French in their Indo-Chinese possessions. Even in Turkey in Asia, where serious difficulties are encountered by explorers, such men as Ramsay and Maunsell have done much valuable work.

Turning to America, the surveys of Canada and of the United States have made great advance in the accurate mapping of their respective countries, while much has also been done in Mexico and in Central America. The Argentine Republic and Chile have made great progress in the exploration and mapping of their territories, and Peru and Bolivia have within recent years shown creditable diligence in this respect; but there remain in the southern continent areas covering from two to three million square miles still practically unexplored, so that to-day, as far as preliminary exploration is concerned, there is more to be done in South America than in Africa.

I have, perhaps, sufficiently indicated the marvellous progress of exploration of the lithosphere. I have naturally less to say of the advance of oceanography, for the *Challenger* expedition had completed its voyages before the jubilee meeting of the Association in 1881, although the results were not then worked out. It is, indeed, only within the last few years that Sir John Murray has been able to complete this immense work, which occupies no less than fifty volumes. Since the voyages of the *Challenger* there has been no equally extensive expedition for oceanographic work, but the study of the oceans has been carried on steadily, if slowly. The German expedition in the *Valdivia* added much to what the *Challenger* had achieved, especially in the Indian ocean; where also, only within the last year, Mr. Stanley Gardiner has carried out an enterprise which promises to yield results of the first importance. Further east, in the seas around the Malay archipelago, the Dutch *Siboga* expedition added something to our knowledge of the ocean bed; and not less important than any of these later expeditions was the enterprise carried out over a series of years in the Pacific and in the Gulf of Mexico by Mr. Alexander Agassiz, entirely at his own expense. The cable-laying companies have also done a good deal on behalf of oceanography, and some of the results of their investigations have been published by the Royal Geographical Society, under the superintendence of Sir John Murray. The immensely valuable work constantly carried on by His Majesty's surveying vessels, under the direction of the Hydrographic department of the Admiralty, is so generally known as to make it unnecessary for me to dwell upon it.

Long before the close of the nineteenth century, however, oceanic navigation had ceased to be of a pioneer or exploratory character, except in the polar regions, and had devoted itself to the no less important tasks of filling in details and of undertaking scientific research, while the comparatively new subject of limnology, which deals with those other portions of the hydrosphere known as lakes or inland seas, and which has had such immense and valuable labour devoted to it in this country by Sir John Murray, falls strictly within the limits of scientific research. To this end all geographical travel and all geographical study must come; and I am thus led to the second branch of my address, dealing with the growth of the scientific side of our subject and the concurrent spread of interest in its study. On these points I propose to deal mainly with our own country; but I shall be compelled to draw certain comparisons, however unwillingly, with the more advanced conditions, in this respect, of other countries, and notably of Germany. No one, indeed, could assert that the importance of problems relating to the geomorphology of the lithosphere, to the distribution of land and water, and to the influence of these (combined with climatic conditions) upon the distribution of life and on human interests were not recognized amongst us long before the last meeting of the British Association at York. The underlying principles of scientific geography have been perceived in all ages and in all countries by a few thinkers; but so late as twenty-five years ago a true conception of the functions and scope of geography was confined to a very limited circle of specialists. In confirmation of this, I may remind you of an inquiry

which the Royal Geographical Society undertook about that time into the position of geography at home and abroad.

For many years previously the Society had been endeavouring to awaken the public mind as to the high capabilities of geography when dealt with on scientific lines, and to encourage the teaching of the subject on a higher plane by the award of medals on the results of examinations. The failure of these attempts induced the Society to make the investigation to which I refer, and its report (published only a few years after the York meeting) may be regarded as the starting-point of the revolution that has since occurred. It was found that Germany even then had professors of geography in nearly all its universities, and a number of thoroughly trained and earnest students who devoted themselves to investigation of the subject in all directions; and that in Austria, as well as in Germany, geography had attained a position, both in universities and in schools of all grades, practically on a level with other subjects of education; while in this country it was generally regarded with apathy, and even contempt. It had no place in our universities; it was barely tolerated in our secondary and higher schools; while in the simple geography of our elementary schools there was great room for improvement. Practical work in geographical research scarcely existed, except in so far as it was an outcome of geology. There was no encouragement for students, there was no high-class geographical literature, such as existed in Germany, and for standard works we had to resort either to that country or France. The great treasure-house for geographers was Elisée Reclus's 'Géographie Universelle,' which, fortunately, was translated into English. There existed, indeed, a few popular works in this country, but these were more or less of a purely descriptive and unscientific character, excluding altogether the fundamental data of the subject. In the Society's report to which I have referred were also given very interesting quotations from the opinions of head masters of English public schools as to the value of geography and the educational position which it ought to have. It was melancholy reading. Only a few of them took a favourable view of the subject, while the majority treated it with little respect. The remarks of those who favoured its study are to-day chiefly interesting as showing the entire inadequacy of the methods of geographical tuition in those days, and the little importance attached to it in educational circles. I must, however, quote with approbation the words of one master, who said, "I feel strongly the great importance of the subject, not only as a mental discipline, an essential part of a liberal education, but as more especially necessary for Englishmen, many of whom will be called upon in after-life to turn their geographical knowledge to practical and serious account;" and he added, "One of the difficulties in doing justice to the claims of the subject is the somewhat absurd prejudice in teaching geography, as if it were less worthy of first-rate men than Latin prose, or essay writing, or criticism." On the other hand, most of the head masters throw cold water on any attempt to give geography a substantial place in our great public schools. They considered it not sufficiently important as an educational instrument; it was hardly a discipline; it was little more than an effort of memory; it was quite worthless educationally till it became a branch of history; problems in it could not be set. These masters were supported by the opinion of a distinguished geologist that geography was not suitable as a university subject because it was a "graphy," and not a "logy." Nor, indeed, can it be contended that these depreciatory views of geography, as it was then generally taught, were unreasonable. The text-books of that time were, as a whole, worthy of the position which the subject held in the education of the country, and on a par with its reputation among the educated public. The use of maps in the daily newspapers was almost unknown; while as regards military geography, the late Lord Napier of Magdala, at the opening of the

Education Exhibition of the Society, forcibly contrasted the position at home with the importance attached to the subject in the German army, where at the manœuvres every third soldier has a map of the ground, and where in the Franco-German war maps formed part of the equipment of every company. If the position of geography in this country was so unsatisfactory a quarter of a century ago, it was not because its raw material was wanting in our language. On the contrary, few countries then possessed a literature of travel and exploration so wide and of so high a class as ours. The source of our weakness was the paucity of men qualified to apply scientific method to this raw material, and there was no institution where it was possible to obtain a thorough training in geography, such as could be obtained at a score of universities in Germany, Austria, and France. This was the position which had to be faced before placing the subject on a more satisfactory footing.

It is unnecessary for me to describe in detail the methods adopted by the Royal Geographical Society—so far as its resources and influence permitted—in carrying out the work of reformation. I need only bring before you the general results. No one will now doubt that the active minds in this great movement were right in believing that the surest means of influencing our schools of all grades, and also of obtaining in the country generally a recognition of the subject as a department of science, as a field for research, and as a subject of practical importance in various spheres of national activity, was to obtain, in the first place, proper recognition at our great universities. Attempts had, indeed, been made in the same direction as far back as 1871 and 1874, but without effect. I need hardly remind you that the later efforts of the Society had a very different result. For many years now there has been a school of geography at Oxford, while a readership established at Cambridge several years ago has also developed into a fairly well-equipped school. At Oxford there is a reader with a staff of three lecturers, and a diploma in geography is granted which practically amounts to honours in the subject. The field covered may be seen from the subjects of examination for this diploma. They are: (1) Regional Geography; (2) Climatology and Oceanography; (3) Geomorphology; (4) Ancient Historical Geography; (5) Modern Historical Geography; (6) History of Geography; and (7) Surveying. It may give a more complete idea of what English students regard as included in their subject if I mention the principal topics in the examination on regional geography—the cartographical analysis of the physical regions of the world—an elementary knowledge of the chief generalizations regarding the surface forms of the land; the movements of air and water, and the distribution of plant associations, animals, and man; the chief facts of modern political and economic geography, considered in relation to the influence of physical features. Candidates are also required to be familiar with the principles of map-making by plane-table, prismatic compass, and clinometer, with the representation of relief, and with the orientation, reading, and measurement of maps. Equally thorough and exhaustive are the various topics included under the other heads of examination. Both in ancient and modern historical geography the subject has to be considered in relation to the influence of physical features. The standard adopted at Oxford is as high as that which exists at any university in Germany. The establishment of a school at Cambridge being recent, one cannot yet speak as positively of its success as in the case of Oxford. But Cambridge has gone a step further than Oxford in placing geography as a subject in the examination for its B.A. degree; and while that may be regarded as a simple pass, the student may also enter for the examination for the diploma in geography, the standard of which is no less high than that at Oxford, while the ground covered is essentially the same. In both universities the training in cartography and surveying is thorough, and it is to be hoped that such students as propose to follow either a military or a colonial career

will take advantage of the opportunity thus presented. The example of Oxford and Cambridge has been followed elsewhere, though to a lesser extent. In the University of London there is a board of geographical studies, and the subject holds a substantial place in the University examination, and is a compulsory subject for a degree in economics. There are chairs or lectureships of geography at Victoria University, Manchester, at the University of Liverpool, and at the University of Birmingham. Steps are being taken to establish a chair at the University of Edinburgh; while other institutions of a similar kind would be glad to follow the example of the great universities if only their funds permitted. In the elementary schools the programme is nearly all that can be desired, the one thing needed here, as elsewhere, being a sufficiency of teachers who have been thoroughly trained in the subject. In the secondary schools progress has been somewhat more slow; but there has been a steady advance in recent years, and a step recently taken by the Board of Education, in issuing a very satisfactory syllabus for the teaching of geography, is certain to give a strong impetus to the subject. In the London School of Economics, under the directorship of Mr. Mackinder, which is attended annually by over a thousand students, geographical teaching holds a place of the first rank. The publishers have kept pace with this great revolution in the schools, so that to-day there is no difficulty whatever for any one, from the elementary school up to the university, in obtaining a text-book, or an atlas, or special maps suitable for his requirements. The country has been, indeed, almost flooded with cheap atlases issued in parts, some of them of a highly creditable quality, while the slides of photographs taken by explorers are sold by the thousand for educational and lecture purposes.

The main cause of this remarkable growth of interest in geography amongst our educated classes dates back to about three years after the last meeting of the Association at York. In 1884, Germany, which in the middle of the century had been still said to rule the air (while France ruled the land, and Britain the sea), and which in later years had been absorbed in the process of unification by blood and iron, suddenly launched out as a world power, and gave the signal for the partition of Africa. England and France, in both of which countries a few men had been carefully preparing, during several years, for this inevitable partition, hastened to join in the international race, and the spirit of colonial expansion, long dormant, reawakened, and reached out to all parts of the Earth where settled government did not forbid advance. We, who have lived through the last quarter of a century, are apt to underestimate the revolution through which we have passed, for a true analogy to which we must go back to the Elizabethan age. The impulse given by this movement to the study of geography can hardly be overestimated. War has been called the best teacher of geography, and certainly Napoleon, the highest exponent of the art of war, was as ardent a student of geography as he was of mathematics; but now it appears that empire-building is an even greater factor than war in advancing and popularizing geographical knowledge. Amongst the educated classes of England, France, and Germany, and, in a lesser degree, of Italy and Belgium, there are few persons who have not had relatives or friends engaged as explorers, or missionaries, or officials, or soldiers, or traders in previously little-known parts of the world, while countless numbers have been concerned in the new movement through vast shipping and other interests that shared in it. The Press, which prior to 1884 had paid little attention to the outlying lands in question, gradually devoted more and more space to everything connected with them, and continually produced most useful maps, showing not only their physical features, but also their economical conditions. It is not my business here to attempt to forecast the judgment of the future historian on the more general results of this colonial expansion, but he will assuredly recognize

its enormous effect on popular attention to geographical subjects, as well as, or even more than, on exploration.

It must not be inferred that the popularity of a subject is taken by me as a test of its place in the ranks of science; but, owing to the widening of the area from which students can be drawn and men of genius evolved, this democratization of geographical ideas is, to my mind, a very hopeful feature as regards the future of the scientific treatment of the subject.

I should have to extend my address to undue length if I attempted to demonstrate the recent growth of the scientific method at home by giving you even an imperfect catalogue of the geographical books and papers of a scientific nature published during the period under consideration, and especially in later years. I can only select for mention a few typical books, such as Dr. Mill's 'International Geography,' Mr. Mackinder's 'Britain and the British Seas,' Mr. Hogarth's 'Nearer East,' and Sir Thomas Holdich's work on 'India,' and other works in Mr. Mackinder's series entitled 'The Regions of the World.' As to papers dealing with this kind of work, I will mention those by Messrs. Buckman and Strahan, giving the results of their investigations on the river systems of the west of England; by Mr. Cooper Read on the river system of East Yorkshire; by Dr. Herbertson on the major natural regions of the world, and on the distribution of rainfall over the Earth's surface; by Mr. Chisholm on the distribution of towns and villages, and on the geographical conditions affecting British trade; by Messrs. Smith, Lewis, and Moss on the geographical distribution of vegetation in England and Scotland; by Mr. Marr on the waterways of English Lakeland; and last, but not least, by Dr. Mill on the Clyde Sea Area, on a fragment of the geography of England and Wales viewed geographically. It must, indeed, be confessed that in this respect we are still behind Germany, which has been pouring forth a mass of geographical literature of the highest scientific value. But this backwardness is the result of past neglect of the subject, and not of present apathy. There was a current saying a quarter of a century ago that the schoolmaster was abroad. I have shown you that, in a different sense, the geographer was then abroad; but I believe that we may now say that the geographer is at home and has come to stay. There is a whole school of young geographers—not yet very large, but zealous and active—full of the new ideas, the new methods, the new hopes of our rising science, and I do not think it too sanguine to expect that when the British Association holds its centenary meeting, twenty-five years hence, perhaps in this very city of York, our countrymen will be found to occupy the same position in the front rank of scientific geography that their forefathers held in pioneer exploration.

THE RECENT CALIFORNIAN EARTHQUAKE.

The Commission of Inquiry into the earthquake phenomena in all parts of the state of California, which was appointed immediately after the earthquake of April 18 last, has issued a preliminary report, the most interesting part of which is a description of the proximate cause of the earthquake. The coast ranges of California are crossed obliquely by a peculiar set of surface features, not due to atmospheric or stream erosion, but to a dislocation, or rather a series of dislocations, of the Earth's crust, with a differential movement on either side of the plane of rupture. In general this line follows a system of long narrow valleys, or, where it passes through wide valleys, it lies close to the base of the confining hills; but in some cases it passes over mountain ridges or crosses a spur or shoulder of a mountain. Along this line are abrupt changes in the normal slope of the ground, giving rise to scarps, to small basins or pools, and occasionally to trough-like

depressions bounded on either side by scarps. In many cases these features have been so modified and softened down by weathering that only the expert eye can detect their abnormal character, but where the line traverses the more desert part of the coast range, as, for example, in the Carissa plains, they are known to the people of the country, and the aggregate of the features is commonly referred to as the "earthquake crack." This line has been traced from Point Arena to the vicinity of Mount Pinos, in Ventura county, and is either continued even further to the south-east, or a similar set of features comes in, in echelon, and can be traced to San Jacinto, on the south-east border of the Colorado desert. Leaving the southern extension out of the question, this very remarkable physiographic line has a length of 375 miles from Point Arena to Mount Pinos, and crosses obliquely the entire breadth of the coast ranges. Throughout its length it affords every evidence of recurrent differential movements extending far back into the Quaternary period.

The earthquake of April 18 was due to one of these movements, but the extent of the rift along which it took place is not yet fully known. Direct field observations have shown that it extends certainly from the vicinity of San Juan, in San Benito county, to Point Arena, a distance of 185 miles; but the destruction at Petrolia and Ferndale, in Humboldt county, indicates a northerly extension of the rift at least as far as Cape Mendocino, thus making the total length at least 300 miles. Along the 185 miles of this rift, where movement has actually been observed, the displacement has been chiefly horizontal, on a nearly vertical plane, and the county to the south-west of the rift has moved north-westerly, relative to the county on the north-east of the rift. The evidence of rupture and differential movement along the line of rift is clear and unequivocal; the surface soil presents a continuous furrow, generally several feet wide, with transverse cracks, showing very plainly the effect of torsion within the zone of the movement; and all roads, fences, pipe, and other lines which cross the rift have been dislocated. The amount of dislocation varies; in several instances it did not exceed 6 feet, a more common measurement is 8 to 10 feet, while in one case a roadway was found to have been moved no less than 20 feet. Probably the mean value is about 10 feet, and variations from this are due to local causes, such as drag of the mantle of soil upon the rock, or excessive movement of soft incoherent deposits. Besides this general horizontal movement, there is observable in Sonoma and Mendocino counties a differential vertical movement, not exceeding 4 feet, so far as is known, whereby the south-west side of the rift was raised relatively to the north-east side so as to present a low scarp facing the north-east. This vertical movement diminishes to the south-east along the rift-line, and is scarcely, if at all, recognizable in San Mateo county; still further south there are suggestions that this movement may have been in the reverse direction, but this needs further study. As a consequence of this movement, the latitudes and longitudes of the trigonometrical stations occupied by the Coast and Geodetic Survey must have altered to a measurable amount, and the commission expresses a hope that these stations may be re-occupied. From another source we learn that it has been decided to do so, and the re-triangulation is to be carried far enough eastward to connect the redetermined points with stations that may safely be regarded as quite beyond the effect of the recent movement.

The remainder of the preliminary report is devoted to an account of the organization of the investigation and a brief account of the principal facts known; of no great importance in itself, enough is said to show that the earthquake of April 18 is one of those which are likely to add materially to our knowledge of the principles of seismology, and it is gratifying that its investigation should have fallen into such capable hands, and be uncrippled by any lack of funds or workers.

R. D. O.

THE VALPARAISO EARTHQUAKE.

THE earthquake which laid Valparaiso in ruins at about quarter-past seven on the evening of August 16, or shortly after midnight by Greenwich time, affected a region which has been made classic by Charles Darwin's researches into the changes of level produced by the earthquake of November 19, 1822. It is the third great earthquake which has occurred on the west coast of America during the present year, the other two being the Colombian, of January 31, and the Californian, of April 18. Like this last, it found a large city within the area of destructive violence, and, like it, the horrors of the earthquake were followed by fire. So far as can be gathered from the telegraphic reports, the shock was an even greater one than that which destroyed San Francisco; though it is difficult to disentangle the truth from the exaggerated accounts which have been telegraphed to the daily newspapers, it seems certain that the shock was of destructive violence, accompanied by widespread ruin and loss of life from Ilapel on the north to Talca on the south, a distance of over 250 miles, and was felt over a much larger area, whose limits it is not possible to define. It is to be feared that this earthquake will not receive the same thorough investigation which is being accorded to the Californian one, and this is to be regretted, as it seems to present problems of great interest. One of these is the explanation of the absence, so far as reports go, of any sea-wave on the American coast, though sea-waves were recorded on the tide-gauge at Honolulu, and observed on the coasts of the Sandwich islands. At Honolulu the oscillation is reported to have been only 3 or 4 inches, but at Mani and Hilo the waves were 5 feet high, and in the enclosed Bay of Maalea reached 12 feet. The time at which these waves were recorded shows that they were originated by the earthquake; they were, however, small in comparison with the sea-waves of the Peruvian earthquake of May 9, 1877, which had a height of 58 inches at Honolulu and 36 feet at Hilo. These sea-waves point to a submarine origin of the earthquake, while the distribution of the damage done shows that the line of fissure, along which the earthquake must have originated, passed inland somewhat to the north of Valparaiso, running in an approximately north-to-south line, with a slight easterly trend. We are still uncertain whether the disturbance of the sea-bottom, which gave rise to the sea-waves, was accompanied by any permanent change in the relative level of land and sea. Some of the earlier accounts made specific mention of alteration in the shore-line after the earthquake, but, according to a later account, soundings taken at sixty-four places in the Bay of Valparaiso showed that there had been no important change in the bottom of the bay. This does not, however, prove that no change has taken place, for it would not require an important change in the depth of water to account for the earthquake and its sea-wave, nor is it impossible that there may have been important changes further north, though not at Valparaiso.

Two statements regarding this earthquake, which were given prominence in the daily papers and have received the sanction of a scientific weekly, may be rejected as mythical. The first of these is that the destructiveness of the earthquake at Valparaiso was intensified by that city being built on granite, and the second is the reported destruction of the island of Juan Fernandez. It is a well-established principle that earthquake shocks are more destructive on soft ground than on hard, and the details of the destruction at Valparaiso show that here, as at San Francisco, the damage was greatest in the business quarters, situated on low-lying made ground, while the fact that the residential quarters on the surrounding hills suffered severely shows that Valparaiso lay nearer the focus of its earthquake than did San Francisco. The reported destruction of the island of Juan Fernandez called forth many

articles of a sentimental nature, but the earthquake certainly did not destroy an island lying at a distance of 400 miles, larger than Jersey, and rising 3000 feet above the sea. Possibly the low-lying part of the settlement, not the island itself, was wiped out by the same sea-wave which visited the coasts of the Sandwich islands.

R. D. O.

REVIEWS.

AFRICA.

The Nile.

Survey Department, Egypt. 'The Physiography of the Nile and its Basin.' By Captain H. G. Lyons, F.R.S. Cairo, 1906. Pp. viii. + 412. *Maps and Diagrams.*

Year after year light is being poured into the dark parts of the Sudan, and piece by piece the mysteries of the ancient river, the Nile, are being unfolded to an inquisitive generation. Junker, Schweinfurth, Marchand, Emin, Donaldson-Smith, and others have all taken their share in the work, and although there is still abundant field for the explorer and the sportsman up the courses of unknown Nile tributaries and along undiscovered watersheds, it may be said that the geography of the Nile basin, so far as the main features are concerned, is pretty well known.

In 1904 appeared the exhaustive report of Sir W. Garstin, closely followed by that of Sir W. Willcocks. Now we have the very interesting volume of Captain H. G. Lyons. Garstin and Willcocks wrote first as engineers concerned in the water-supply of Egypt. Captain Lyons writes as an engineer, a geographer, a meteorologist, and a geologist. His volume now before us consists of 387 pages of very solid matter, bristling with figures, and containing forty-eight plates and diagrams. There is not a page of padding or spinning out in the book. In fact, it is to be regretted that Captain Lyons did not develop some of his arguments more fully. They are so condensed as sometimes to be not very easily followed. It is, therefore, difficult to review such a book within reasonable length for an article for this journal.

There is little to be gained from disputing what is the source of the Nile. Garstin pronounces emphatically that the great reservoir of the Victoria Nyanza, covering an area of 24,000 square miles, is the true source of the river. But if it be measured by the volume which it contributes to the common stream north of the junction of the Victoria with the Albert Niles, then the latter river must be taken as the true Nile, having its source about lat. 1° 30′ S., where "the Great Rift" is finally blocked by the mountain masses of volcanoes rising to a level of above 12,000 feet, which form the watershed of the basins of the Nile and the Congo. Moore points out that this great obstruction across the long valley of the Albert Edward and Albert lakes is the result of a "comparatively recent volcanic outburst," before the occurrence of which the waters of Lake Kivu, which now discharge into Lake Tanganyika, probably flowed north into the Nile. It seems possible, then, that at one time the long course of the Nile was still longer, and its source was to be found south of Tanganyika.

The volume of water coming from the Victoria lake and flowing past Fowera to join the Albert branch is nearly constant, and amounts to about 20,000 cubic feet per second. The volume contributed by the Albert branch, on the other hand, is a very variable amount, ranging from a minimum of 17,000 to a maximum of 35,000 cubic feet per second. The reason assigned for this difference is the evaporation and the moderating influence of the vast water-surface in the Victoria lake and of the marshes of Lake Choga to the north. The rainfall, too, in the Great Rift, especially at the southern end under the Ruwenzori mountains, probably much exceeds

that of the basin of the Victoria lake. Observations are naturally very scanty, however, and we cannot quite be satisfied with the explanations given by Captain Lyons for this remarkable difference. We may be sure that the last word has not yet been said as to the variations in the discharge of the Nile and its many branches.

The water-surface of the Victoria lake stands at a level of about 3700 feet, and that of the Albert at about 2300 feet, above the sea. Down this slope of 1400 feet the Nile has to flow in a course of 250 miles. The Ripon falls are 16 feet high. Below this for 40 miles the river flows on a steep slope; then for 150 miles sluggishly through marsh and shallow lake. Willcocks estimates that the loss by evaporation in these great sheets of water must be as great as the gain by rainfall. On emerging from these swamps the river flows with a gentle velocity and a navigable stream for about 80 miles, when it again enters on a long series of cataracts and rapids, ending in a narrow cleft in the rock wall not 20 feet wide. Through this cleft the whole river rushes and thunders over the Murchison falls, a drop of 140 feet. A short distance below this the Victoria and Albert branches of the river unite.

Captain Lyons thus briefly sketches the geology of the southern part of the Nile: "A plateau lying some 1500 metres above sea-level, and composed of gneiss, quartzite, and schists. The central portion is occupied by Lake Victoria, while the deep fault valley in which Lakes Albert Edward and Albert lie forms the western portion. Much movement has taken place comparatively recently, and blocks of the plateau have been raised, lowered, or tilted, so that the drainage follows the depressions so formed. As yet the rivers have not had time to deposit or erode sufficiently to give a regular grade to their beds, so that marshes and water-logged depressions still alternate with reaches in which the fall is considerabie, and the flow therefore rapid."

About 10 miles from the north end of the Albert lake the river flows in one channel about half a mile wide, between high and well-defined banks, and although there is no rock anywhere near the surface, Sir W. Garstin considers this the spot where a regulating weir ought to be thrown across the river, should it be determined to control the waters of the Albert lake, a measure which will certainly be undertaken some day. For about 140 miles from the end of the Albert lake the flow of the river is gentle, and navigation not difficult, though obstructed by papyrus marshes, and then begins a wild descent of 100 miles, in which the river falls 730 feet. In some of these cataracts the river is not 40 feet wide, and must be of great depth. The last of them is known as the Fola rapid. From this point, for a distance of 1150 miles the navigation would be uninterrupted, save for the very formidable obstructions known as *sadds*, to be alluded to later on, masses of vegetation that rapidly block the whole course of the river. The river, which is here known as the Bahr el Gebel, has now deserted the plateau of the lakes, formed of gneiss and other rocks, and henceforth to the Mediterranean, a distance of nearly 3000 miles, it flows through an alluvial plain, unbroken save by the dykes of rock which create the six cataracts north of Khartum. Hitherto it has passed through mountain country. Now it is in the plains. Away 50 miles to the east is visible the great hill mass of Agoro, rising to a height of nearly 10,000 feet above the sea. On the west the hills rise steeply to a height of about 4000 feet, attaining to what is believed to be a high plateau, but it is largely unexplored.

In this part of the Sudan the temperature does not vary 5° between the hottest and the coldest month, the average of the year being about 79° Fahr. The rainfall is about 40 inches, of which 33 fall in the months from May to October.

Captain Lyons remarks that "it has been known for years past that the rainfall on the more elevated parts of its basin supplies the Nile, but the statement that

melting snows also play a considerable part still lingers, although, except for a few streams fed by the melting glaciers of the Ruwenzori, no snow-water reaches the Nile." We could have wished that Captain Lyons had told us where the melted glacier-water of the Ruwenzori all goes to, if a considerable proportion does not find its way into the Nile. Surely we have not sufficient data to go on to pronounce very positively on this question.

Captain Lyons objects to Willcocks' description of the Bahr Gebel, south of Lake No, as being deltaic, "since a delta is formed when a stream delivers its load of detritus into a body of still water, such as a sea or lake." But we think the term *deltaic* is capable of a wider signification. The course of a large river may generally be divided into three sections. At first it rises among mountains, or flows down very steep slopes, scouring its banks and bed, and carrying with it a quantity of detritus. During the next section the river flows through the foot-hills. The slope of the country and the consequent current is diminished, but is still sufficient not to continue scouring, but to float on the detritus brought from above. In the third section there is not force enough to carry on the detritus, which therefore deposits in the bed, and in the lake or sea into which the river discharges, and this we consider the deltaic stage. There is certainly no lake in this part of the Nile valley, but Captain Lyons calculates the slope of the Bahr Gebel as 1 in 24,000, a condition not very far removed from a lake. The explanation he gives, in page 144, of this part of the Nile's course is not very clear or convincing.

From Gondokoro to Lake No is a distance of about 414 miles, and for the northern 250 miles of this distance the river is liable to be blocked by *sadds*. These consist of tangled masses of three aquatic plants, the *papyrus*, the *Phragmites communis*, and the *Vossia procera* reed. On either side of this portion is a series of vast shallow swamps. These plants are bedded in the soil below the water. Their hold on the wet earth is lessened by the force of the wind, and if the water-surface rises the roots become detached from the soil, with earth adhering to them, and retaining them in a vertical position; the wind and current carry them into the sluggish stream of the river; a *snag* projecting in the stream checks their course; another floating island catches on to the first, and, as Sir W. Garstin says, "a strong gale may set hundreds of acres of these floating masses moving in one direction. When the surface of the water is blocked, the succeeding masses get sucked down, until at last the whole becomes wedged into one solid block, . . . not infrequently attaining a thickness of 5 metres." This blocking of the waterway naturally raises the up-stream surface, flooding the marshes right and left till the river manages to find a side channel, or until the obstruction in the main channel at last bursts, and the river clears itself. There is record of a *sadd* of this description forming afresh seventy days after being cleared.

Notwithstanding that there is an annual rainfall of at least 39 inches over the catchment basin of the Bahr el Gebel, and that it receives from the lake plateau from 17,000 to 35,000 cubic feet per second, and although this vast swamp is the natural outfall of the Bahr el Ghazal and of many tributaries as far as the distant plains of Darfur—in spite of all this, and incredible as it appears, the volume of the river up-stream of the junction of the Sobat does not exceed a constant supply of 16,600 cubic feet per second. Willcocks is positive "that the *sadd* region is unmistakably . . . an old lake which has silted up and become full of peat and sand deposits." Garstin is inclined to the same belief, but Captain Lyons pronounces this merely an hypothesis, and gives geological reasons for opposing it which seem sound.

For about 500 miles above Khartum, where it is joined by the Sobat, the Nile has no very considerable tributary. The Sobat is a very important factor in the hydrography of the Nile basin. For the first 125 miles its course is through the

Abyssinian mountains, whence it carries forward great deposits of silt to be dropped whenever it reaches a more moderate slope. For the remaining 340 miles of its course it meanders through almost level plains. The Sobat attains its maximum (at least 25,000 cubic feet per second) in September and October, but there is no room in the valley of the Nile at this season to allow the Sobat water to proceed northward in its course. A much greater river—the Blue Nile—is then in force, and this holds up the White Nile, the Sobat, the Bahr el Gebel, and all its tributaries.

From the junction of the Sobat to Khartum the slope of the White Nile is rarely more than 1 in 100,000. This extremely low slope renders the channel a vast reservoir, with (according to Captain Lyons) a storage capacity of about 53,000 million cubic feet.

So far, we have been considering the branch of the Nile that descends from the Lake plateau, and more or less serves to drain the great swamps that lie about 550 miles south of Khartum, while it receives the waters of the Bahr el Ghazal from the west. The basin of the White Nile and its tributaries vastly exceeds that of the Blue Nile and Atbara, but it is these last that create the wealth of Egypt.

The rainfall over this part of North-East Africa decreases from south to north, and so it happens that, while the Sobat is still in high flood up to December, the Blue Nile, which rises 6° further north, falls rapidly throughout October, and has a very modest discharge in January, by which date the Atbara has ceased to flow altogether and is merely a series of pools. Yet at its maximum in September the Blue Nile is discharging about 400,000 cubic feet and the Atbara 70,000 cubic feet per second. It is the water ponded up in the White Nile that keeps up the supply in Egypt until the end of December. For six months after that Egypt depends on the supply coming down from the lake plateau. The Blue Nile and the Atbara take their rise among the lofty mountains and elevated plateaus of Abyssinia, rising to a height of from 15,000 to 6000 feet. It is this high mountain region crossing the path of the monsoon current which causes the heavy rainfall which supplies the Sobat, the Blue Nile, and the Atbara. The slope to the west is gentle, and so most of the rivers flow in this direction in channels deeply eroded and devious in their courses. Of these the largest and most important is the Blue Nile, known in the upper part of its course as the Abai.

The geological formation here, as in general over the Eastern Sudan, consists of granite and gneiss, varied by tracts of lava and basalt. Embedded among these mountains, at an elevation of about 5800 feet above the sea, lies the beautiful Lake Tsana, covering an area of about 1200 square miles, from the south end of which flows the Abai or Blue Nile, the discharge of which Mr. Dupuis found to be, on January 31, 1903, about 1500 cubic feet per second. A marked feature of the Blue Nile and the other rivers of Abyssinia is the deeply eroded channel through which, by the most devious courses, they come out at last on to the plains of the Sudan. The gorge of the Titta, for instance, is 3400 feet high.

For some 500 miles of its course from Lake Tsana the Blue Nile flows through hilly country. From Roseires onward to Khartum, a distance of nearly 400 miles, it flows through wide-stretching plains covered with low scrub jungle until the approach to Wad Medani, the most important town on the Blue Nile, with a population of some 20,000, the capital of the Sennár province. Here we get into abundant *dhurra* or millet cultivation. When the population has been replaced which was exterminated in the Mahdi war, and when a reasonable sum has been spent on irrigation works, the country between the two branches of the Nile should be one rich field of fertility, not inferior to the Nile valley of Egypt. From Khartum northwards the Nile valley is now so well known that it may be only briefly noticed here.

One fact is dwelt on by Captain Lyons. In the great tourist season of Cairo, the opinion is often expressed that the climate is changing, and whereas rain was formerly unknown in Egypt, it is now a yearly occurrence; and this is put down by some to the Suez canal, by some to the extension of irrigation since the English occupation. Reference to the Memoirs of the learned staff brought to Egypt by Napoleon at the end of the eighteenth century, shows that as the climate was then so it is now. "But at least," says the tourist, "no rain falls in Upper Egypt." And when he looks out from the hotel verandah at Aswan and sees the clouds pouring forth their supply, he is convinced that this must be a very exceptional year. Captain Lyons, talking of the Nile valley from Aswan to Cairo, remarks, "A few rainstorms occur every winter, but they are usually very local in their effect. On the eastern side the much larger area and the steeper slopes, together with the greater frequency of rain near the Red sea hills, make the winter rainfall a more important factor. In about every second year one or other of the larger *wadis* comes down in flood, sometimes so suddenly as to carry away camels and sheep which may be grazing in the valleys, and pours a large volume of water into the Nile. . . . These *seils* [or rain floods] are less rare than is usually supposed, and the dry arid appearance of the desert, together with the rareness of rain, cause the effect of such storms as do occur to be underestimated."

Captain Lyons may be congratulated on having brought out a very important addition to Nile literature. In a country until lately so very little known as the Sudan, it is quite wonderful how many valuable observations and statistics he has managed to collect together. This book must, in every way, rank very highly as a scientific geographical treatise. Everywhere he employs the metric and decimal system of notation, and in Appendix I. he gives, for the sake of the unlearned, conversion tables, so they cannot complain. But why does he not give us a table for converting square kilometres into square miles? and why will he not leave us our familiar Fahrenheit thermometer. Wherein is the Centigrade to be preferred?

The National Printing Department of Cairo deserves credit for turning out so good a work, probably the best they have ever done; but they might have given us a thicker cover than this wretched sheet of paper, and they should remember that the English synonym for a weir has not got the letter *n* in it (see p. 133).

C. C. S. M.

Liberia.

'Liberia.' By Sir Harry Johnston, G.C.M.G., etc. With an Appendix on the Flora of Liberia, by Dr. Otto Stapf. 2 vols. London: Hutchinson & Co. 1906. *Price* 42*s. net.*

Liberia, says Sir Harry Johnston, by reason of its fauna and flora, is a peculiar country almost rising to the dignity of a distinct sub-district of the West African sub-region. Nevertheless, Liberia is of interest chiefly by reason of the racial, social, and political problems there on trial. This fact the author recognizes by placing the history of the republic in the forefront of his narrative. The story of the endeavour to evolve a self-governing civilized negro state is clearly set forth. Into the controversy as to what lines of development the Liberians ought to pursue if they are to maintain a permanent place among the nations of the world we do not propose to enter, beyond stating our general agreement with Sir Harry Johnston that the ideal which they now cherish, namely, that of an Anglo-Saxon culture of the early nineteenth-century type, is not that suited for an African people. But the author, in his zeal and the plenitude of his knowledge, has done more than give the history of Liberia; he has devoted five or six chapters to the oft-told tale of Hanno's Periplus; to accounts of the voyages and traffickings of the Normans, Portuguese, English, and Dutch along the Grain Coast; and to a *résumé* of the slave trade and piracy

practised in that and neighbouring regions. Much of this has no special connection with Liberia, but the author justifies himself by identifying the references made in the old chronicles to places now within the limits of the republic, thereby contributing a valuable page to the elucidation of historical geography.

Apart from its historical matter, the scope of the book will be best exhibited by indicating in the author's order the contents of the two handsome volumes. In the preface Sir Harry acknowledges his indebtedness for much of his information to a number of scientists and others, especially to Dr. Otto Stapf, of the Botanical Gardens, Kew, who has contributed the appendix on the flora of the country (Sir Harry has, however, considerable and recent personal knowledge of Liberia, and appears to have made a special study of its native races and economic condition). After the preface comes an analytical bibliography, which the student will find very useful. A generous tribute is paid to the valuable work of Dr. Büttikofer, especially in the subject of biology. Next we have an introductory chapter in which the topography of Liberia is broadly outlined, and this is followed by another, called "Ancient History," largely devoted to speculative ethnography. Thus early the author discloses his admiration for the Mandingoes, a virile race professing Islam, and among the aristocrats of West Africa. From this point we are taken through the history of the country, the first volume concluding with chapters on commerce, geography, climate and rainfall, geology and minerals. One of the facts demonstrated is that the transplanted American negroes and mullattoes are almost as much aliens in the land of their ancestors as are the white intruders, and are subject to the same climatic disabilities.

With regard to the geography of Liberia, Sir Harry Johnston has little to add to existing knowledge as the result of his own journeys, but he ably summarizes all that is known of the country. We get a vivid picture of a land of primeval forest —the densest forest region in Africa—hilly generally, and mountainous in parts; short, rapid, and usually unnavigable rivers; pestilential lagoons; a harbourless coast, with one bold cliff rising over 1000 feet sheer from the water; magnificently coloured flowers, birds, and beasts; a land of heavy rain and humid heat. In its outlines at least it does not differ greatly from other West African countries.

The first prices quoted in the chapter on commerce are these: "The value of wives varies in different districts, but an average may be struck—viz. 6 brass kettles, 15 kegs of powder, and 5 pieces of cloth. The value of a slave-boy is 15 kegs of powder, and of a slave-girl 10 kegs of powder or 100 sticks of salt." However, all the commerce of Liberia is not of this type. The staple exports are coffee, rubber, palm oil, palm kernels, and piassava. The extraordinary wealth of rubber-producing trees, lianas, and shrubs indicates that with proper management, and the provision of better means of communication, the rubber industry might become an important source of wealth to the community. There are only slight indications of the existence of minerals of commercial value, though the sand of some of the rivers is auriferous.

The second volume opens with an account of the Liberian flora, followed by Dr. Stapf's appendix already mentioned. Then come four chapters devoted to fauna; three chapters on anthropology—historical (there is here some repetition of information given in vol. 1), physical, and social. The nearest approach to an indigenous race are the Kru and Kpwesi people, and concerning these tribes much illuminating information is forthcoming. Chapters on folklore, languages, and vocabularies end the volume, save for the index, which, so far as we have tested it, is satisfactory.

Much of the value of this book, a monument of industry and insight, lies in its illustrations and maps. Sir Harry Johnston has a reputation as an amateur artist, and twenty-eight of his paintings are reproduced in colour; those of birds and beasts

are specially good. There are twenty-four botanical drawings by Miss Matilda Smith, and over four hundred other illustrations. These help materially to the understanding of the text. Of the maps two are reproduced from the *Journal*; others are useful sketch-maps, showing rainfall, forest region, political boundaries, etc. There are, besides, two contoured maps, drawn by Mr. J. W. Addison, on the scale of 1 : 1,000,000—one of Western Liberia, the other of Eastern Liberia.

F. R. C.

AMERICA.

The Volcanoes of Colombia.

'Die Vulkanberge von Colombia.' | By Alphons Stübel. (Edited and completed by Theodor Wolf.) Dresden: 1906.

By the death of Stübel in November, 1904, the science of vulcanology lost one of its greatest masters. After spending a great part of his life in the active investigation of the volcanoes of Central and South America in the field, he had returned to Germany, and it was expected that a series of monographs giving the results of his work would ultimately appear. The present volume is a companion to his well-known book on the volcanoes of Ecuador, and is written in the same clear and graphic language, but, unlike the previous work, is accompanied by an excellent series of panoramic views of the principal mountains described. The book is concluded by a sketch of the operation of the volcanic forces, an elaboration of the author's theoretical views on this subject which have already received much attention from geologists.

J. S. F.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Geomorphology.

'The Face of the Earth.' By Prof. E. Suess. Authorized English Translation by Hertha B. C. Sollas, under the direction of Prof. W. J. Sollas. Vol. 2. Oxford: Clarendon Press. 1906.

The second volume of Miss Sollas's translation of Prof. Suess's great work fully bears out the promise of the first. It is in every sense an excellent version, presenting in clear and most readable English the intricate and often difficult matter of the original. The German edition is followed very closely, even though in some respects it would not be hard to introduce improvements. Thus, for example, no one would complain if an index, however brief, had been added to the work; and again, while some of the illustrations have been adapted to the use of English readers (*e.g.* Fig. 29), there are others in which the German nomenclature still stands. It seems unusual to find, in a book for the use of English students, a map of Scotland with such terms as Hebriden Inseln, and Nord Canal (Fig. 10).

This volume is devoted to the history of the oceans, and contains much of the most brilliant speculation associated with its author's name. It has excited great controversy, and has evoked much criticism, not entirely favourable. As a masterpiece of the literature of physical geography and geology it has long since taken its place among the classics of science. The simplicity of the main conceptions in this part of the work makes it on the whole most suitable for the general reader, though it is by no means easy reading. The enormous mass of detail on the geological structure and history of the Earth's crust which its pages contain are apt to fatigue the mind and to overpower our sense of proportion; but the author never flags. He brings each chapter to a close with a masterly generalization, summing up in a few brief paragraphs the results of our geological knowledge of half a continent.

In order to establish the differences which exist between the Atlantic and the Pacific ocean, the geological history of much of the adjacent continents has to be unfolded. A comparison is drawn between the structure of Northern Europe and of

North America, in which it is shown how many features these ancient lands have in common, and the very perfect balance between the two sides of the Atlantic is gradually demonstrated. Incidentally the history of the older mountain chains of the world is sketched, as a sort of appendix to the story of the Alps and other mountains already described in the first volume. It is shown how the Atlantic is an ocean bounded mostly by broken fragments of continental masses. The long and intricate story of the Mediterranean must also be told in order to explain many exceptional features of the Atlantic shores. The Pacific, on the other hand, is surrounded everywhere by folded ranges which on the whole run parallel to the strand, and are accompanied in a more or less regular fashion by the volcanoes which constitute the great Pacific zone of fire.

We then pass to consider another question of the highest importance, with which the name of Suess will always be associated. The ridging up of the Earth's crust by the formation of mountain chains has hitherto been one of his principal themes. The question he now asks is this: Can we recognize another type of earth-movement by which the land is slowly upheaved or submerged over great areas without marked folding? The raised beaches, so well known to all geographers, have long been held to prove that such changes have gone on extensively in comparatively recent times. But after a review of all the evidence, which amazes the reader by the intimate knowledge shown of the geological literature of all countries, the conclusion is arrived at that there is no good proof that the land has experienced elevation and depression of this nature. The explanation hinted at is that the changes have been in the level of the sea. But the argument is destructive rather than constructive.

Whatever verdict posterity may bring in on this question, the surpassing interest of this volume cannot be gainsaid. Every chapter is full of geographical speculations which fire the student's imagination. The importance of the book must be measured rather by the influence it has exerted on geological thought than by the rigidity of its demonstrations and the ultimate triumph of its teaching. Those who know it well in its German and French editions will welcome the appearance of so good an English translation, while those who never read it before may be congratulated on having it prepared for their use in so acceptable a form.

J. S. F.

GENERAL.

Surveying Instruments.

'Instrumentenkunde für Forschungs-Reisende.' Unter Mitwirkung von Ingenieur C. Seidel bearbeitet von W. Miller. Hanover: Jänecke. 1906.

Among the numerous works that have been published during the last few years on scientific observations for travellers and the necessary outfit, that entitled 'Instrumentenkunde für Forschungs-Reisende,' by Profs. C. Seidel and W. Miller, ought certainly to be classed with the most useful and practical. At the first glance it has somewhat the appearance of an ordinary catalogue of instruments by different makers, but it is in reality far more than this, for although it gives lists and illustrations of theodolites, sextants, barometers, photographic apparatus, instruments for marine surveying, for magnetic observations, and indeed the necessary outfit for almost every conceivable branch of scientific investigation that an explorer can undertake, with particulars as to price and weight, yet it is in no wise confined to a bare list, but contains valuable information as to principles of construction, variety of form, and many other subjects that cannot fail to make the work of considerable value and practical importance. One important subject dealt with is the customs tariffs for scientific instruments in different countries, a list of which is given, followed by useful information concerning frequency and dates of departure of steamships by which instruments may be sent from Hamburg to all parts of the world.

As might perhaps be expected, this is essentially a German work, and by far the greater number of the firms of instrument makers are German. Still, this is not entirely the case, and since makers in other countries are included, it is surprising that the list is not more complete in this respect. For instance, nearly all the more important makers in this country are omitted from the general list, although the names of some incidentally appear in the list of scientific outfit of the Japanese government surveying ships. Again, as to instruments, there are some important omissions, such as the Lloyd-Creak magnetic instrument, from the list of instruments for magnetic observations. No reference is made to the plane-table, of which many forms exist, and which instrument is admitted by the best authorities to be specially suitable for rapidly filling in topographical features between fixed points on a survey. Amongst the apparatus for photographic surveying, it is surprising that the Bridges-Lee photo-theodolite, certainly one of the best, is omitted.

Hints to Travellers.

'Anleitung zu wissenschaftlichen Beobachtungen auf Reisen.' Herausgegeben von Prof. Dr. G. von Neumayer. 2 vols. Third edition. Hanover: Jänecke. 1906. *Price* (*vol.* 1), 25*m.*, (*vol.* 2), 24*m.*

If the geographical explorer of the present day fails to bring back valuable scientific results of his travels, or is at a loss to know how to preserve his health in the region he may visit, or what instruments he should take with him, it can hardly be due to the fact that no instructions have been published for his guidance; for apart from works dealing with special subjects, of which several have lately appeared, almost simultaneously with the new edition of this Society's 'Hints to Travellers,' a third edition of Dr. G. von Neumayer's 'Anleitung zu wissenschaftlichen Beobachtungen auf Reisen' has been published. Although both of these works are intended to furnish guidance for the intending travellers on scientific matters, the latter, since it now consists of two octavo volumes, each containing over eight hundred pages, is perhaps more fitted for previous careful perusal than to furnish practical hints in the field. Still, to many the bulk may not be a serious difficulty, and on important expeditions, the traveller acquainted with German would doubtless consider that the valuable information the 'Anleitung' contains far more than compensates for its weight and size.

The work is certainly most exhaustive and complete, and no less than thirty-two professors and experts have contributed articles on the particular branch of scientific inquiry which they have specially made their own. To give merely a brief notice of each of these would be impossible in these pages, and if any fault can be found it is that too much has been attempted for the purpose in view, and that the average traveller would have profited more if less had been given and the matter had been more condensed.

That the latest discoveries and results of the most recent investigations have been taken advantage of may be seen from a glance of such articles as that by Prof. S. Finsterwalder on "Photography as an Aid to Land Surveying;" Dr. G. von Neumayer and Dr. J. Edler's on "Magnetic Observations on Land;" the important notes on "Magnetic Observations on Board Ship," by Dr. Friedrich Bidlingmaier; the article by Dr. W. Köppen on the "Use of Kites in Meteorological Observations;" and many others. A special interest attaches itself to the article on geology, inasmuch as it was the last work of the kind undertaken by its illustrious author, the late Baron F. von Richthofen.

Very properly, the opening section of the work, written by Herr P. Vogel, is devoted to fixing positions by astronomical observations; but considering the importance of this subject, and the amount of detailed information contained in many

of the others, this section is hardly so complete as might have been expected. In addition to bare statements of formulæ, it would have been an advantage to the ordinary explorer if more fully worked out examples of the computations had been given, and if matters such as telegraphic determination of longitude, and longitude by occultations of stars, had received more adequate attention. The astronomical section is followed by one on route-surveying and triangulation by Herr P. Vogel; and here again some important matters, such as plane-table surveying, and the more exact methods of computation of geodetic distances, have hardly received the attention they deserve. Still, both of these articles are good so far as they go, and those on nautical surveying and photographic surveying give valuable additional information on these matters.

In conclusion, Dr. von Neumayer may be congratulated on the publication of the third edition of this most useful work, and the amount of labour and painstaking care which its venerable editor must have devoted to its supervision is decidedly remarkable, when it is remembered that he has now reached his eightieth year.

THE MONTHLY RECORD.

EUROPE.

The Peopling of Switzerland.—An article by M. Pierre Clerget in the *Bulletin* of the Belgian Geographical Society (1906, No. 2) on the peopling of Switzerland, gives a clear and detailed account of the relation between the geography of that land and its population. To its mountainous and therefore retired character, Switzerland owes its preservation of the Romansh language; to its central position, the fact of its having been peopled from prehistoric times. All the epochs between the ages of stone and of iron have been brought to light, and that not only in the lake dwellings of Geneva, Bienne, Zürich, and Constance, but also in the region of the sources of the Aar, Kander, Lutschine, Sarine, and Simme. Switzerland falls naturally into the regions of the Alps, occupying 59·1 per cent. of the total surface, the Jura 11·4 per cent., and the intermediate plateau 29·5 per cent. These three regions have each a distinctive density and character of population determined by its special geography. Its general elevation, however, assigns to Switzerland the rearing of cattle as its principal occupation. The vine is cultivated in Valais. In the Alpine valleys fruit trees, cereals, etc., grow, while industries, such as the working of marble, granite, and slate, exist. There is, moreover, abundant reserve of water-power, a factor of vast capacity, but its exploitation lies in the future. The characteristic employment, however, of Switzerland is cattle-rearing. That fact carries with it a wide dispersion of the population. The great longitudinal valleys are more populated than the much more narrow and abrupt lateral ones. The highest inhabited villages are in the Grisons. More than half the people of that canton live well above 3000 feet, two-fifths of them above 3800 feet. The great valleys bear on their slopes terraces due to glacier action. Where the terraces are well marked we find great administrative communes, often composed of many different centres. The physical factor seems to create political solidarity. Where, on the other hand, the terrace is absent, quite small groups constitute independent bodies. Everywhere alike, too, the sunny side is much more populated than the shady, and the dwellers in the former look down on those in the latter. Included in the interesting article is an account of nomadism, communism, "consertages," etc., all of geographical significance. A plate shows the migrations to and fro of the dwellers of Chandolin, between the Rhone valley and the Alps from January to December.

Population of German Towns in the Middle Ages.—The population of the leading German towns in the Middle Ages is a question which has long been the subject of inquiry. Thanks to some lucky finds made in ancient town archives, it is now possible to state, according to official enumerations of the fifteenth century, the figures of population of a number of such communities, in part with complete authenticity (as in the case of Nürnberg), in part with a high degree of probability. The following is a list of such towns:—

Town.	Year of enumeration.	Population.
Strassburg	1473–77	26,198 *
Nürnberg	1449	25,982 †
Lübeck	end of 14th century	22,300
"	end of 15th century	23,672
Ulm	1427	20,000
Augsburg	1475	18,300
Rostock	1410	14,000
Zürich	1410	10,570
Frankfurt-on-Main	1440	9000
Basel	1471–75	9000
Eger	1446	7340
Freiburg in Uechtland (Switzerland)	1447–48	5800
" " "	1444	5200 ‡
Mainz	end of 15th century	5767
Nördlingen	1459	5295
Heidelberg	1439	5200
Freiberg in Saxony	1474	5000
Ueberlingen	1444	4800
Dresden	1477	4228
Butzbach	1421	2235
Meissen	1481	2000

On the above data the distinguished Austrian statistician, His Excellence von Inama-Sternegg, makes the following remarks in the *Statistical Monthly* (May, 1906): "This goodly roll of twenty towns suffices to reduce to their proper measure the representations, mostly extravagant, of an earlier time respecting the wealth of population of German towns in the Middle Ages. On this list are included towns, such as Lübeck and Augsburg, belonging beyond dispute, politically and economically, to the most important and influential of their time. It can only be regretted that precisely for the two most important communities of the old German Empire, Cologne and Vienna, no available sources have been discovered for the determination of their population. Were the figures of population for these cities ascertained, they would furnish the high-water mark of city population for Middle Europe in that period. They would, however, further supply evidence that a population which nowadays seems hardly adequate for a modern second-rate town, was yet in those times a factor of great power, not only on account of the generally low standard of population in the empire and its territories, but also by reason of the exceedingly strong tide of rich civic life pulsating in these autonomous communities."

ASIA.

Earth-movements and River Profiles in Peninsular India.—In the *Records of the Geological Survey of India*, vol. **33**, part **1**, Mr. E. Vredenburg calls attention to the marked deviation from the normal displayed by the profiles of several of the rivers of the Indian peninsula, notably the Narbada, and

* Excluding people in transit, 20,722. † Excluding people in transit, 20,165.
‡ Not counting people in transit.

the conclusions to be drawn respecting movements of the surface in recent geological times. The subject is of interest from the fact that the phenomenon seems to be not merely a local one, but to belong to a series of simultaneous movements which have been of considerable importance in determining the existing configuration of large parts of the Earth's surface. The upper part of the Narbada basin is occupied by an immense deposit of Pleistocene alluvium, rich in mammalian fossils, which boring has shown to fill a rock-basin of great depth. On emerging from the alluvial plain, near Handia, the profile of the river becomes suddenly steeper, and from this point to the sea is almost a straight line instead of presenting the curve characteristic of most river-courses with their gradually decreasing fall. The general straightness of course also points to the agency of recent surface changes. Somewhat similar features are observable in the case of other rivers, such as the Tapti, with its tributary the Purna, and the upper Godaveri, all of which traverse planes of old alluvium, on leaving which their gradient becomes markedly steeper. It has been sought to account for this by supposing an uplift of the western side of the peninsula relatively to the eastern, but Mr. Vredenburg points out that the result in the case of the Godaveri would necessarily be the reverse of that in the case of the westward-flowing streams. A more satisfactory explanation would be forthcoming on the supposition of an extensive though shallow warping of the surface along certain definite lines. A single anticlinal ridge, running west of the western end of the Narbada and Purna plains, with a strike slightly east of north, would also cut the upper Godaveri at the lower end of its plain of ancient alluvium, and so account for the accumulation of all three deposits, while a parallel ridge would account for the plain of Khandesh. Similar exceptional features in the profile of the Rhine are also largely due to Pleistocene crust-movements, while many features of northern topography, *e.g.* the Swiss and North American lakes, have been ascribed to similar and contemporaneous agencies. In the latter cases glacial conditions played their part, but the simultaneous occurrence of Earth-movements in a country where glaciation, at the time, is out of the question, strengthens the idea that the ice had little more influence than to preserve the effects of such deformation. Such a widespread warping of the surface in Pleistocene times would be a remarkable fact, but further data from regions intervening between India and Europe are needed. Mr. Vredenburg suggests the possibility that the present isolation of most of the drainage of Persia and neighbouring countries may be in part the result of similar movements.

Dr. Tafel's Journey in North-West China.—A further letter from this traveller (*Journal*, **27**, 302), printed in the *Zeitschrift* of the Berlin Geographical Society (1906, No. 5), continues the account of his interesting researches down to February 25 last, at which date he was at Hsi-ning, in the Kuku-nor region. The previous letter had left the traveller at Kwei-hwa-cheng, near the north-eastern angle of the course of the Hwang-ho. Great scarcity was prevailing in this district, and the traveller comments on the absence of enterprise on the part of the mandarins, who, by inaugurating a system of irrigation, might make of the neighbouring Hwang-ho valley a veritable granary. Kwei-hwa-cheng is well known as a centre of the wool trade between China, Mongolia, and Northern Tibet, and the traveller gives some interesting details as to the method of transport, and so forth. From this place he travelled to Bautu, on the Hwang-ho, making a circuit through the mountain range to the north, the In-shan of the maps, though the only name current in the country is Da-tsing-shan, as it is correctly given by Rockhill. It consists mainly of steeply inclined Archæan formations, and forms a very rugged wall-like escarpment with an undulating steppe beyond. In this region the Chinese are pressing back (or assimilating) the Mongols, but their agricultural operations

are limited by want of rain, which falls regularly only in the hills. From Bautu (which has nearly the same importance as Kwei-hwa-cheng) the traveller crossed the Hwang-ho valley, the southern part of which is a useless steppe, and ascended to the moderately elevated Ordos country. Here too the Mongols are being rapidly displaced by Chinese, who now form more than half the population. The first part of the Ordos country consisted of horizontal strata rich in silicates, sand being hardly anywhere seen. The grassy plain was covered with vast herds of sheep and camels belonging to the Mongols under the Ordos chief Wang. Further south sand became more and more plentiful, forming great barchanes and blocking many of the original valleys. At length hills appeared to the south, and the towers and battlements of the Great Wall appeared. It is here composed entirely of blocks of loess, which here makes its appearance. The wall is threatened by the advancing sands from the north, as well as by the loess itself, and the city of Yu-lin is likewise half buried in sand. No traveller had previously made his way to this place in foreign dress, and Dr. Tafel was subjected to much annoyance. South of this he crossed a low range formed by a gigantic wall of loess over 1500 feet thick, and seeming to represent the Lu-kwa-ling of the maps. Beyond Anbien he left the main road to Ning-hia, in order to touch the northern spurs of the Liu-pan-shan. The formations here showed traces of much dislocation and pressure, and the structure was difficult to make out. Dr. Tafel endeavoured to follow the Hwang-ho from Chung-wei to Lan-chau, but found that it passed through a wild gorge, impassable by foot-passengers, having here to break through the extreme easterly spurs of the Nan-shan. The population was exceedingly scanty, and from what he saw, Dr. Tafel is inclined to put the whole population of Kansu at far less than has been supposed—some two or three millions only. From Lan-chau he made his way to the country north of Kuku-nor, but his caravan was attacked by Tibetans and forced to beat a retreat. He hoped, however, after renewing his equipment, to carry out his intended journey through north-eastern Tibet.

Ascent of Cherimai Volcano.—The *Tijdschrift* of the Royal Netherlands Geographical Society for March last gives a provisional notice of an ascent, made on December 24 and 25, 1905, of the gigantic volcano of Cherimai, in Java. Previous ascents were those of van Blume (1825), Junghuhn (1837), and van Hoëvell (1844). This last ascent was made by Heer J. A. Deknatel and five other mountaineers from Linger Jati, east by north of the summit. Starting at 7.30 a.m., the expedition climbed on horseback till 9. Beyond the top of Gedeh, their path ran without a break through dense primæval forest. Then, rising into the zone of European vegetation, they experienced great difficulty in breathing, the heart's beating being felt up to the throat on making a ten minutes' climb. At 3 p.m. they were within 1000 feet of the pinnacle. After a further climb of three-quarters of an hour, four of them reached the rim of the crater at 5.45. The cavity, with its continuous rumble and sulphurous steam, made an unspeakable impression. All around, however, was dense fog. Descending to their hut within 1000 feet from the top, where they passed a cold night with the thermometer at 47°, they started again next morning at 4, and reached the top at 5. At 5.30, under the rising sun and a cloudless sky, they had a view extending from far beyond Pekalong to Krawang, with the sea in front, and in the distance the peaks of all the volcanoes of mid-Java. Starting at 7.30, four of them made the circuit of the crater in two hours.

The Name Halemahera (Jilolo).—The derivation and meaning of the word "Halemahera" is discussed in the *Tijdschrift* of the Royal Netherlands Geographical Society, vol. **23**, No. 2. In an earlier number of the same journal, the word was represented as Tidorese, and as signifying "Mother of the land," relatively to which Tidore was island, "child of the land." A letter from P. A. Oudemans in the above

journal quotes a passage from F. S. A. de Clercq, stating that the name means support or foundation of the land, and should properly run Halémahéra. Halé, however, is Tidorese, corresponding to the Ternatan "Kaha," though nobody thinks of saying "Kaha-ma-hera." In Tidorese pure and simple, the name would be "Haléjorah," and nobody can explain the barbarous combination of the two languages. Following a peculiarity of the whole of the Indian archipelago, the natives constantly speak of "Halmahera"—"great land"; but the people of Ternate apply the half Ternatan and half Tidorese "Halemahera," and the people of Tidore the word "Halejorah," to the largest of the Moluccas proper. Herr Oudemans further cites an authoritative passage, showing that, according to Oviedo, the name Halmaheira properly applies only to a province. The island of Jilolo was by the inland people called "Aliora." There is a reply to this letter by J. A. F. Schut in the same journal.

AFRICA.

The Ascent of the Ruwenzori Peaks.—Full details as to the recent ascent of the Ruwenzori peaks by the Duke of the Abruzzi and his companions are not yet forthcoming, but a letter from one of the latter, Signor V. Sella, communicated to the *Times* by Mr. Douglas Freshfield, makes some addition to the vague information previously available. Signor Sella says that the duke, accompanied by two Courmayeur guides, climbed all the five highest peaks of the range, and took from them observations with a mercurial barometer as well as a number of compass bearings. Captain Cagni carefully measured a base-line near Bujongolo, in order to ascertain the exact distance of the summit of Kiyanja from the rock shelter Kichuchu, so that the resulting map of the snowy portion of the chain will have a firm basis. Signor Sella also made several ascents and obtained a number of photographs and panoramas, including views in the forests and valleys of the Mubuku and Bujogo. The latter is said by him to be the largest tributary of the Mubuku, so that, as Mr. Freshfield points out, it seems to be of more importance than has been suspected. As regards the height of the highest peaks, all the information given is that they are several hundred feet higher than Kiyanja and to the north-west of it. It will be remembered that the height obtained for Kiyanja by the British Museum party (*Journal*, July, 1906, p. 50) was 16,379 feet, but this was by aneroid and boiling-point thermometer only, and may be in excess of the truth. In any case there is no reason to suppose that the height of the culminating point will greatly differ from that given by Lieut. Behrens, in the July number, to the higher of the two peaks identified by him with Stuhlmann's Kanyangungwe. A sketch-map sent by Signor Sella to Mr. Freshfield places the various summits in positions closely approximating to those of Lieut. Behrens, the highest summit of the Italian traveller corresponding to Kanyangungwe of Lieut. Behrens. The position of Kiyanja, however, according to Sella, corresponds to that of the peak estimated by Behrens to have a height of 15,692 feet, and identified by him with the Ngomwimbi of Stuhlmann. If this was really Kiyanja (of which Lieut. Behrens obtained, otherwise, no observations), it would help to explain the fact that Mr. Wollaston placed the higher peaks seen by him at some miles from Kiyanja, though in this case the direction given by him (due north) would not be quite intelligible.

New Route to Lake Chad.—Considerable activity is being displayed in the attempt to open up a new route to Lake Chad through the French Congo colonies, by way of the upper Sangha and Logone rivers. In the July number of *La Géographie* particulars are given of an expedition which was carried out in the latter half of 1905 by Lieut. Lancrenon, of the French Colonial Artillery, while on his way to take up a post in the Chad territory. Acting under special instructions from M. Gentil, the Commissary-General of the French Congo, Lieut. Lancrenon organized a

caravan at Carnot, on the Mambéré branch of the Sangha, with the object of exploring the little-known country between that station and Lai, on the Logone. No similar expedition had been undertaken since Captain Loefler's journey in 1901 (see *Journal*, vol. **20**, p. 540). Though he covered a great deal of new ground, Captain Loefler was unable to establish the desired connection between Carnot and Lai, his route on the northward journey trending eastwards to the Shari, while on the return journey, after traversing the Tuburi marsh, he reached Carnot by a route which ran for the most part a considerable distance west of the Logone. The very heavy mortality among the porters who engaged in this earlier expedition made it extremely difficult for Lieut. Lancrenon to secure natives to act as carriers. A start was finally made from Carnot early in July, 1905. The expedition first made its way to Kundé, and then turned to the north-east in the direction of the Logone. The region traversed presented features of great orographical and hydrographical interest. Several rivers, confined within narrow and precipitous valleys, descend from the Adamawa highlands towards the Logone and the Shari; and of one stream, the N'gu, the course was found to be broken by a cataract between 300 and 400 feet in height. The Logone was struck not far from a mountain mass named Bumbabal, which dominates a wide expanse of country. Some of the tribes encountered had not even heard of a white man, and the early stages of the expedition were peaceful in character, but in the Laka country the attitude of the natives became decidedly hostile. Lai was reached on September 4, after a journey from Kundé of nearly 400 miles through unknown country. Circumstances made it necessary for Lieut. Lancrenon to accompany the expedition on its return journey. On this occasion the country between Bumbabal and Carnot was traversed by a new route which did not touch at Kundé; and when Lieut. Lancrenon again turned north to reach his post in the Chad territory, he sought out a third route between Carnot and Bumbabal, following in part the course pursued by Captain Loefler. What promises to be a still more important expedition has been despatched to the French Congo by the Paris Geographical Society, under the leadership of Commandant Lenfant, with the object of developing communications between the Sangha and the Logone basins. Efforts will also be made to secure reliable data about the economic resources of the country, and to extend French authority among the tribes. The upper Sangha Concession Company has contributed largely to the funds, which, according to the *Dépêche Coloniale*, amount to £7400. Including the leader, the European staff of the expedition will number no fewer than nine members. As might be expected, Commandant Lenfant, who left France for Brazzaville on August 25, will devote special attention to the navigability of the waterways he is to explore. On the way to Carnot some time is to be spent in exploring the forest region around Nola, where the Mambéré and the Kadéï flow together to form the Sangha. Beyond Carnot the plans of the expedition will largely be determined by circumstances. Somewhat different in character is another expedition, which has been organized by the Paris Geographical Society with the assistance of the Pasteur Institute, for the study mainly of the distribution and characteristics of the sleeping sickness in the French Congo, particularly in the upper Ubangi region. A sum of £8000 has been subscribed for the purposes of the mission, at the head of which will be Surgeon-Major Martin, who has had experience of tropical diseases both in Indo-China and in West Africa. The mission is due to start from France this month (October), and will, it is expected, be absent about a year and a half.

São Thomé Island.—A paper by M. Aug. Chevalier, in *La Géographie* (vol. **13**, No. 4), gives a fresh and graphic picture of the Island of São Thomé, in its physical, historical, and more especially economic aspects, as a result of a sojourn of some weeks in 1905. Its population, 38,000, is distributed between the city,

7 villages, and over 200 plantations. There are 2500 Europeans; over 11,000 negroes converted to Catholicism; 2000 Angolan fisherfolk, the descendants of 200 slaves stranded on the coast in 1540; and 20,000 imported labourers, mostly from Angola. By nature a wild chaos of mountains, intersected by ravines opposing the most stubborn resistance to cultivation, the island has, practically since 1870, thanks to prodigious and ingenious industry, been converted into a vast tropical garden of exuberant fertility. Its superabundant watercourses, too, are now being utilized as water-power and for irrigation. Half the island is now under cultivation; a quarter in the centre, occupied with forest, is still capable of plantation; whilst the other quarter—marsh, dunes, and barren almost inaccessible peaks—is economically useless. The climate is mild and humid, with wet and dry seasons, but the temperature hardly varies all the year round. Yet three climatic regions are distinguishable: (1) the north and north-east, comparatively dry; (2) the south and south-west, much more humid; (3) the region of high altitudes. The cultures, again, are divisible into altitudinal zones: that of the oil palm extends from sea-level up to 800 feet; cacao is grown chiefly between 520 and 1300 feet; sugar-cane at low altitudes; *coffea arabica* from 2300 to 4000 feet. The two great products are cacao and coffee. In 1905 the cacao production of São Thomé and Principe (23,187 tons) much exceeded that of Ecuador (18,268 tons), and still more that of Trinidad (18,968 tons); and in a few years the two islands should double their present production. Other cultures are quinquina, introduced in 1864; bananas; and European vegetables, which thrive from 3300 to 4500 feet. In an ascent of the peak, the height of which M. Chevalier places at 6640 feet, he gathered ten species of plants nowhere existing save on the flanks of the mountain.

AMERICA.

Tide-levels and Datum-planes on the Pacific Coast of Canada.—The Canadian survey of tides and currents has lately been extended, under the able direction of Dr. W. Bell Dawson, to the coasts of British Columbia, and an account of the work so far accomplished has been given in a supplement to the annual report of the Department of Marine and Fisheries (Ottawa, 1906). An important piece of work, which had to be undertaken in an early stage of the survey, was the determination of a plane of reference for the height of the tide in the various harbours, and its correlation with previously employed datum-planes. The value of reliable levels is obvious from the point of view of harbour and other public works, as well as for marine purposes, while from a geographical standpoint they are of unusual interest in this particular region on account of the rapid alteration in the relative height of land and sea which seems to be taking place at the present time. The fixing of a satisfactory basis for the tide-levels was the more important on account of the uncertainty prevailing in regard to the datum-planes of important surveys, or the absence of means of correlation, owing to loss of records. The obvious plane of reference to be adopted in connection with tidal observations is mean sea-level, and the unusual character of the tides on the Pacific coast renders it important to adopt the best method of obtaining its value. The leading feature in the Pacific tide is a pronounced diurnal inequality in time and height, according with the declination of the moon, but subject also to an annual variation with the change in the declination of the sun. In the enclosed waters the tide curve has quite an anomalous appearance, the sea often standing for a long time near high-water level, with a sharp and short drop once in the day. The spring and neap tides are thus reduced to a secondary feature. Under these circumstances there is a notable difference between the half-tide level and the true value of mean sea-level, and the determination of the latter requires the hourly ordinates to be taken

throughout the year by a registering gauge. By carrying out this work it is hoped that a basis has been secured by which some approximation to the rate of rise of the land now in progress can be attained. Much pains has also been taken to correlate the various datum-planes which have been employed at Victoria and Esquimault, one most fortunate result being the establishment of the lost Public Works datum (and others depending on it), with the help of a record of which the present engineering staff were unaware.

POLAR REGIONS.

The Polar Conference at Brussels.—Representatives of some of the principal countries and bodies interested in polar research met at Brussels early in September, under the presidency of M. Beernaert, Minister of State, to discuss the proposal for an "International Commission for the Study of the Polar Regions," put forward last year by Belgian representatives at the Economic Congress at Mons. After considerable discussion, a scheme put forward by Dr. Charcot was adopted on September 10, with some modifications, by a committee mainly composed of explorers, and on the following day was accepted by the Congress in plenary session. The commission will be constituted by the inclusion of two effective and two extra members of each country that has taken part in polar exploration, with arrangements for the addition of representatives of countries that may at any time be organizing new expeditions. Corresponding members may also be nominated from the ranks of explorers or others who have carried out scientific research in regard to the Polar regions. The members are to hold office for six years, half of the number retiring at the end of three years, but being eligible for re-election. They are to elect a president, a vice-president, and two secretaries. This scheme is the result of a compromise between the views of those who desired the commission to be composed entirely of polar explorers, and those who wished to give it a more comprehensive character, both as regards its composition and methods of action. It was understood, however, that its scope might be widened in future. At present, at least, it will not organize expeditions on its own account, its main objects being defined as the establishment of closer relations between polar explorers, and the co-ordination of methods of observation. Especial stress was laid on the second of these objects, and it was urged that all oceanographical work should conform to the methods adopted by the International Association for the Study of the Sea.

The Wellman Airship Expedition.—News received at Hammerfest from Mr. Wellman at the end of August was to the effect that, owing to faults in the mechanical equipment of his airship, the voyage northward had been postponed until next year, a possibility which he had kept in view from the first. The preparations in Spitsbergen had progressed satisfactorily, but the car would be entirely rebuilt in Paris during the coming winter.

The Voyage of the "Gjöa."—Captain Amundsen has telegraphed to King Haakon announcing the safe arrival of the *Gjöa* at Cape Nome in Alaska, the north-west passage having thus been completely accomplished by him. King Haakon has signified his assent to the naming of the coast charted by the expedition after himself and Queen Maud.

Mr. Mikkelsen's Expedition.—We have received news from Mr. Mikkelsen bringing the account of his doings down to August 18. He appears to have encountered unusual difficulties at the outset of his undertaking, and was apprehensive of being unable to keep to his programme as regards this year's winter quarters. On the way to Bering strait he had touched, among other places, at St. Lawrence island, where half the required number of dogs—fine, big animals—were obtained. A gale, accompanied by fog, made it impossible, however, to reach the Siberian

coast, and a course was shaped for Port Clarence, but adverse wind and current kept the ship drifting to and fro for three days amid considerable danger. The port was reached at last, but the leader's plans were thrown out of gear by the serious illness of Mr. Detlevsen, necessitating his being sent back, and by the desertion of two of his men. A start was again made on July 22, but the season proved quite an abnormal one—wind and current coming persistently from the north, and making it impossible to make any good progress, owing to the closeness of the ice to the coast. Down to August 18 none of the whalers frozen in last year had made their appearance, and Mr. Mikkelsen's was only the second vessel, and the first sailing vessel, that had made its way as far as Point Barrow, gales and fog continually hindering an advance. At the time of writing there were indications of a southerly wind, and Mr. Mikkelsen hoped that this would make it possible to proceed eastward past the point. He intended to push as far as possible during the month of navigation remaining, and to do as good work as possible wherever it might be necessary to go into winter quarters. Next summer he hopes to carry out the original plan, spending two more years in the Arctic, should the additional funds (some £220) thus made necessary be forthcoming. A further communication may be expected from the explorer after the winter quarters have been reached.

Ice and its Movements in Baffin Bay.—A very thorough study of the movements of the ice in the region of Baffin bay, as a result of currents and weather influences, forms part 7 of the *Veröffentlichungen* of the 'Institut für Meereskunde' and the Geographical Institute of Berlin University. Its author is Dr. Ludwig Mecking, who, after a general discussion of the relative influence of currents and wind on drift-ice, deals in full detail with the effects of both agencies in the area in question. From theoretic considerations, supported also by actual instances, he concludes that while pack-ice is influenced in its movements by any wind that is blowing at the time, and while icebergs are of course moved by the wind when currents are practically absent, the wind has but a minor effect in the case of bergs where definite currents exist. In tracing in detail the effects of currents in the Baffin bay area, the writer has naturally to examine minutely the whole *régime* of the circulation, and this section is perhaps the most important part of the memoir, as some of the conclusions arrived at differ from those of previous writers like Pettersson. In particular, he holds that the so-called "North water," south of the entrance to Smith sound, which is remarkable from its comparative freedom from ice, even in winter, is really Atlantic water, which enters Davis strait as an under-current, and comes to the surface in the far north. Others have considered it to be derived from the relatively warm, northward-flowing, West Greenland current; but besides adducing evidence to show that the Davis under-current is maintained for a long distance through Baffin bay, Dr. Hecking contends that, as there seems little doubt that a movement of cold water takes place southward in the vicinity of Cape York, it would be impossible for the warmer water of the West Greenland current to make its way across this to the position of the North water. Another important point is that of the existence and source of the "middle-ice current," running southwards from Melville bay, which Dr. Hecking considers to receive an impulse from three, more primary, currents (including the Davis under-current), besides that which results from the melting of ice in the bay. In summarizing the general system of circulation, he shows that all the various components combine to feed the great Labrador current, which maintains its unity until outside the limits of the area dealt with. The question of the effects of weather conditions is more complicated, and must be referred to briefly only. Besides causing minor variations in the conditions of ice-drift, weather plays an important part in determining the amount of ice present from year to year in the sea off Newfoundland. Dr. Hecking

points out that it is necessary to deal separately with the sea-ice and glacier-ice. He finds that the amount of the former varies directly with the steepness of the pressure-gradient, during the months November to January, between South Greenland and the mouth of the St. Lawrence. The amount of glacier-ice depends on more complex causes, the weather of the preceding *summer* exercising, however, a predominant influence. In conclusion, the writer points out the need of research to elucidate (1) the question of periodic variations in the amount of ice; (2) the relation between years of abundant ice in the Iceland and Newfoundland waters respectively.

MATHEMATICAL GEOGRAPHY.

Determination of Areas.—The methods by which the superficial areas of continents, countries, islands, and seas were obtained by geographers in early times, and the history of their subsequent development, form a subject that must always be of interest and importance, and it is striking that comparatively little has been written on the subject. True, brief accounts are to be found in the writings of Humboldt, Vivien de St. Martin, Gelcich, and others, but these are far from complete, or deal with the subject from special points of view. This want has now to a great extent been supplied by two important papers by Dr. W. Schmiedeberg, of Leer, which have appeared in Nos. 3 and 4 of the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin* for the present year, under the title "Zur Geschichte der Geographischen Flächenmessung bis zur Erfindung des Planimeters." The subject is dealt with under the three following sections: (i.) From the time of the ancients to the middle of the seventeenth century; (ii.) From the middle of the seventeenth to the middle of the eighteenth century; (iii.) From the middle of the eighteenth to the middle of the nineteenth century. Although the first section contains useful information as to the earliest approximate methods of obtaining superficial areas, it is with the last two that Dr. Schmiedeberg principally deals, and concerning which he has evidently made a special study. In the forty-two pages which he devotes to these latter he gives a most useful account of the various methods by which estimations and measurements of areas were made, with some of the results obtained, making reference to many authorities from whom he quotes. The third section is exceptionally complete considering the comparatively few pages at the author's disposal, and commences with the date of the publication of Büsching's 'Neue Erdbeschreibung,' in 1754, traces the history of the subject down to the year 1850, giving also a short account of the invention of the planimeter, and finishing with a theoretical discussion of the more exact methods and computations for obtaining measurements of large areas and zones, taking compression and the figure of the Earth into consideration. The history and development of the various methods and devices for obtaining superficial areas corresponds pretty much with the history of geographical discovery, and in the earliest times the results were naturally extremely rough and approximate, not only on account of the methods themselves being at fault, but owing to the erroneous conceptions of the land forms and dimensions of the Earth. As geographical knowledge increased, the demand arose for more exact measurements, and with these demands the methods of obtaining them were forthcoming.

GENERAL.

Vacation Course at the Oxford School of Geography.—The third biennial Vacation Course in Geography was held this year from Tuesday, August 7, to Friday, August 24. There were sixty-five students, more than double the number of 1904. Eleven students came with grants from the West Riding County Council, and one with a grant from the Glamorgan County Council. Each morning

lectures were given at nine and at ten in the lecture-room of the University Museum, which was kindly lent by the Museum Delegates. This permitted the preparation of the lecture-room and map-room at the School of Geography for the practical work which occupied the rest of the morning. To avoid overcrowding, the students were divided into three sections, two of which took practical work indoors, while the third carried out exercises in map-making in the field. The work at the School of Geography was carried out by the Reader in Geography and Mr. J. F. Unstead, of Goldsmiths' College, with the assistance of Misses N. E. MacMunn and L. Jowitt, Prof. G. W. Hoke, of Miami University, Ohio, and Messrs. E. F. Elton and H. O. Beckit. The field mapping was under the direction of Messrs. R. Sivewright and B. V. Darbishire. The course was opened by Mr. H. J. Mackinder, who discussed the matter and method of geography, and in illustration analyzed the geographical conditions, physical and political, of the eastern end of the Wealdan area. The other lectures were as follows: four lectures on the Growth of Geographical Ideas, by Mr. C. R. Beazley; four on Greece and Asia Minor, by Mr. J. L. Myres; two on Palestine, by Mr. J. F. Unstead. Eleven lectures were devoted to different aspects of the geography of the British Isles: three by the Rev. E. C. Spicer on its physical features; three on the climate, vegetation and economic natural regions, by Mr. Herbertson; two by Mr. A. M. Bell on the character and origin of the British flora; two on Mediæval Historical Geography, by Mr. P. M. Roxby; and one by Miss MacMunn on the Historical Geography of a County, illustrated by Essex and Cumberland. Five lectures dealt with World Geography: four by Mr. Herbertson, and one, on the distribution of wheat, by Mr. Unstead. One of the most interesting features of the course was due to the presence of three distinguished American professors, who were good enough to lecture on different aspects of the geography of the United States. Prof. Emory R. Johnson, of the University of Pennsylvania, gave two lectures on the Geography of American Transportation. In his last lecture he discussed the probable effects on trade routes of the opening of the Panama canal. Prof. Spencer Trotter, of Swarthmore College, Philadelphia, lectured twice on the Biological Regions of North America. Prof. G. W. Hoke, Miami University, Ohio, gave three lectures on the Social Geography of the Southern Appalachians and their Border. On three evenings there were animated discussions on (*a*) methods of teaching geography in secondary schools (introduced by Miss Cooper, Tutor to Women Students of Education at Oxford); (*b*) appliances (introduced by Mr. M. W. Keatinge, Reader in Education); and (*c*) on syllabuses. Several excursions were arranged to places of geographical interest. Mr. Spicer conducted the students to Shotover; to the Chiltern escarpment; and to Sinodun hills. Mr. Herbertson was leader in expeditions to the Evenlode valley and to the Cotswold escarpment. Mr. Myres showed the students Oxford itself, and the more important exhibits in the Ashmolean and Pitt Rivers Museum.

OBITUARY.

The Rev. George Grenfell.

We regret to record the death, which occurred on July 1 at Bassoko, West Africa, as the result of blackwater fever, of the Rev. G. Grenfell, the well-known pioneer missionary on the Congo, to whom, perhaps, more than to any one man besides, we owed our knowledge of the ramifications of the great interior fluvial system in the years following its first revelation to the world by Stanley.

Mr. Grenfell was born at Mount bay near Penzance in 1849, and educated at King Edward's School, Birmingham. Intended for a business career, he soon decided to give up his prospects in this direction and devote himself to missionary work, being sent out to the Kamerun in 1878, under the auspices of the Baptist Missionary Society. This region was then more of a *terra incognita* than any other part of the African coasts, and during his four years' residence in it, he was able to collect much information on the country and its people which was new to those at home, and which he made generally available in a paper published in the R.G.S. *Proceedings* in October, 1882. Four years before this he had been transferred to the Congo, then attracting universal attention from the efforts of the International Association to open up the unknown interior. He soon proved himself fully capable of making the most of the opportunities for pioneer work thus presented. In August, 1882, he, in company with his colleague, Mr. Bentley, founded the station at Manyanga on the lower river, and soon pushed on towards the interior, where his society, with commendable foresight and enterprise, had decided to place a steamer on the vast navigable system of the upper Congo. The work of transporting this steamer, the well-known *Peace*, through the region of the cataracts, was successfully accomplished by July, 1884, when, in company with his colleague, Mr. J. T. Comber (who had also shared his labours at the Kamerun), Grenfell started on a preliminary trip up the great river. During a five weeks' voyage, the first great tributary above the falls (now known to be identical with the Kasai) was ascended to a point above the junction of the Kwango. Soon afterwards a more extended voyage was made, the most important result of which was the discovery (accidental in the first instance) of the great northern tributary, the Ubangi. This was ascended during the return voyage as far as 4° 30′ N., the great probability of the identity of this river with the Welle of Schweinfurth being thus demonstrated. The important southern tributary, the Lomami, had also been ascended for a considerable distance, as far as 1° 50′ S., and the mouths of other tributaries examined.

These geographical labours were not allowed to interfere with Grenfell's primary work as a missionary, to which he devoted himself with unflagging zeal to the last. But he realized the importance, for his own work no less than that of other Europeans on the great river, of obtaining as clear a knowledge as possible of his field of operations. He therefore continued to take every possible opportunity of adding to our knowledge of the great river system, and during further voyages in the *Peace* and the companion vessel, the *Goodwill*, he was able to throw additional light on the courses of other important tributaries, especially the Kasai, which he ascended as far as its junction with the Lulua. The preliminary results of these surveys were given to our Society in 1886. In 1887 he ascended the Kwango to the Kikunji falls and made a large scale survey. His survey of the perplexing course of the main river, with its infinity of interlacing channels, was continued as opportunity offered, the result being a large-scale chart based on something like 200,000 cross-bearings, 1500 sextant and theodolite observations for latitude, and 1200 for time and longitude. A reduction in ten sections was eventually published in the *Journal* in November, 1902.

Mr. Grenfell had from his boyhood taken a keen interest in geography, and this natural bent no doubt had a good deal to do with the precise direction taken by his life-work. He joined the Society in 1882, and watched with appreciation its efforts to improve the status of the subject in the schools of this country. In 1887 he was the recipient of the Patron's Medal, given in recognition of his important services to geography during his long residence in West Africa.

CORRESPONDENCE.

The Phœnician Periplus of Africa.

As Mr. E. J. Webb groups me with those who appeal to the "Phœnician legend" of the circumnavigation of Africa in support of their view regarding the great antiquity of the Rhodesian monuments, I should like to say that I do not rely at all on the statement of Herodotus, which I none the less hold to be no "legend," but the truthful record of an historical event. In this I am supported by such weighty names as H. Wagner ("Phœnicische Schiffer umfuhren . . . den ganzen Erdtheil, begünstigt durch die Meeres-Strömungen an der Küste von Afrika," 'Lehrbuch,' Book **6**, p. 190), E. Reclus ("the first voyage of circumnavigation, mentioned by Herodotus" (vol. **10**, p. 27 of my English edition)), Dr. J. S. Keltie ("there is no difficulty in crediting the story" ('Partition of Africa,' p. 8)), and many others, to whom Mr. Webb will scarcely venture to apply his caustic remark about "ignorance of elementary astronomy." I, no doubt, refer to the subject (*Geographical Journal*, vol. **27**, p. 338), but that is only to refute Mr. MacIver's paradoxical statement that the ancients had no knowledge of the Austral regions. The story is also mentioned in my 'Gold of Ophir,' p. 94, but only in a casual way, and no argument is built upon it.

Mr. Webb asks, if Herodotus is to be believed about the Phœnician circumnavigation, "why does no one believe him when he goes on to speak of a Carthaginian one?" The reply is that this is just what Herodotus does not do. He nowhere mentions a Carthaginian "Periplus," not even that of Hanno, which may have got as far as the Bay of Bissagos. What he does mention, immediately after the Phœnician story, is that of the ill-starred Sataspes (Book **4**, par. 43), which was sent, not by the Carthaginians, but by Xerxes, who impaled or crucified (ἀνεσκολόπισε) the unsuccessful prince on his return to court. Why Posidonius is introduced I fail to see. No doubt he tried to discredit Herodotus; but so he did Eratosthenes too, and, in his attempt to correct that great mathematician's calculation of the circumference of the Earth, made a lamentable blunder which retarded the progress of geographical studies for many generations.

A. H. Keane.

Mr. Webb seems somewhat to miss the point of those who regard the statement that the sun was on the right hand during the supposed circumnavigation as tending to confirm its truth. Surely the natural conclusion to be drawn from it is not so much that the sun was north at noon, as that it was, during the greater part of the day, on the right of the general course sailed. This could only be the case if the navigators reached a part of the coast with a decided trend to the west, which, of course, would not be possible unless they at least approached the southern extremity of the continent. The statement would also seem to point (for all that Mr. Webb says to the contrary) to a position well within the southern hemisphere, for nowhere north of the equator at least would the sun's general position (*i.e.* for any considerable part of the day or year) to the right of an east-to-west course be so marked as to call for special comment. There is no need to suppose that the statement "startled the world." It merely proved unacceptable to Herodotus, who was hardly remarkable for acuteness of perception, and whose whole attitude in the matter was obviously influenced by preconceived ideas.

Edward Heawood.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full :—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C. R. = Comptes Rendus.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
k. u. k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (mét.) = Meteorological, etc.
P. = Proceedings.
R. = Royal.
Rev. (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selskab.
Sc. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Alps—Geology. *C. Rd.* **142** (1906): 666–668. **Argand.**

Sur la tectonique de la zone d'Ivrée et de la zone du Strona. Note de Emile Argand.

Alps—Simplon. **Brunhes.**

Les Relations actuelles entre la France et la Suisse et la Question des voies d'accès au Simplon. Par Jean Brunhes. (Extrait de la *Revue Économique Internationale*, Février 1906.) Bruxelles: Office de la Revue. Size 9½ × 6½, pp. 56. *Maps, Plan, and Diagrams. Presented by the Revue Economique Internationale.*

Noticed in the April number (vol. **27**, p. 403).

Andorra. *C. Rd.* **142** (1906): 662–663. **Chevalier.**

Sur les glaciers pleistocènes dans les vallées d'Andorre. Note de Marcel Chevalier.

Denmark—Tides. **Paulsen.**

Die dänischen Wasserstandsmessungen und einige Resultate derselben mit Bezug auf den Einfluss des Windes auf die Höhe des Wasserstandes. Von A. Paulsen. (*Meteorologische Zeitschrift*, Hann-Band, pp. 97–110.) Braunschweig: F. Vieweg und Sohn, 1906. Size 12 × 8. *Map and Illustrations.*

France. *C. Rd.* **142** (1906): 600–603. **Glangeaud.**

Une chaîne volcanique miocène sur le bord occidental de la Limagne. Note de P. Glangeaud. *With Sketch-map.*

France—Basses Alpes. *C. Rd.* **142** (1906): 605–608. **Martel.**

Sur le grand cañon du Verdon (Basses-Alpes), son âge et sa formation. Note de E. A. Martel.

France—Coasts. **Joubin.**

Cours d'Oceanographie fondé à Paris par S.A.S. le Prince Albert de Monaco. (Deuxième Année.) Considérations sur la Faune des côtes de France. La répartition des animaux dans ses rapports avec la nature des rivages. Les côtes rocheuses. Par L. Joubin. (*Bull. Musée Océanographique de Monaco*, No. 71 (1906), pp. 26.) *With Maps and Illustrations.*

France—Corsica. *Riv. G. Italiana* **13** (1906): 126–132. **Marinelli.**
Notizia di una grande carta manoscritta della Corsica. Olinto Marinelli.

The map, of whose author only the initials "F. M." are known, seems to date from the first half of the eighteenth century.

France—Geology. *Ann. G.* **15** (1906): 168–172. **Margerie.**
La nouvelle édition de la Carte géologique de la France à l'échelle du millionième. Par E. de Margerie.

France—Jura. *B.S.G. Lille* **45** (1906): 140–152. **Perron.**
Le Jura Central. Par Abbé Perron. *With Illustrations.*

France—Puy-de-Dôme. *C. Rd.* **142** (1906): 663–665. **Glangeaud.**
Les volcans du Livradois et de la Comté (Puy-de-Dôme). Note de P. Glangeaud.

France—Pyrénées-Orientales. **Buffault.**
B.S.G. Com. Bordeaux **29** (1906): 101–107, 128–135, 145–154.
La Forêt de Laroque-des-Albères. Notes et souvenirs d'un forestier. Par Pierre Buffault. *With Illustrations.*

France and Germany. *Contemporary Rev.* **89** (1906): 505–517 **Boulger.**
The Franco-German Frontier. By D. C. Boulger.

Germany. *Petermanns M.* **52** (1906): 49–59. **Rauers.**
Zur Geschichte der alten Handelsstrassen in Deutschland. Versuch einer quellenmässigen Übersichtskarte. Von F. Rauers. *With Map.*

Germany—Bavaria. *Sitz. K.B.A.W. München* 1905 (1906): 447–476. **Endrös.**
Die Seiches des Waginger-Tachingersees. Von A. Endrös. *With Map.*

Germany—Meteorology. **Hellmann.**
Die Niederschläge in den Norddeutschen Stromgebieten. In amtlichem Auftrage bearbeitet von Prof. Dr. G. Hellmann. 3 vols. Berlin: Dietrich Reimer (Ernst Vohsen), 1906. Size 11 × 7½, pp. (vol. 1) vi., 386, and 140; (vol. 2) viii. and 722; (vol. 3) viii. and 872. *Map and Diagrams. Presented by the Author.* [To be reviewed.]

Germany—Meteorology. **Kremser.**
Ergebnisse der Beobachtungen an den Stationen II. und III. Ordnung im Jahre 1900 zugleich Deutsches Meteorologisches Jahrbuch für 1900. . . . Von V. Kremser. (*Veröffentlichungen K. Preuss. Meteorolog. Instituts*, 1900, Heft iii.) Berlin: A. Asher & Co., 1906. Size 13 × 10, pp. xxiv. and 123–272. *Map and Frontispiece. Presented by the K.P. Meteorologischen Instituts.*

Holland. *Ts. K. Ned. Aard. Genoots. Amsterdam* **23** (1906): 561–563. **Baren.**
De seculaire daling van den grondwaterspiegel op de Veluwe. Door J. van Baren.

Hungary—Winds. **Hegyfoky.**
Ueber Berg- und Talwinde in Ungarn. Von J. Hegyfoky. (*Meteorologische Zeitschrift*, Hann-Band, pp. 59–67.) Braunschweig: F. Vieweg und Sohn, 1906. Size 12 × 8.

Italy.—Piedmont. *C. Rd.* **142** (1906): 809–811. **Argand.**
Contribution à l'histoire du géosynclinal piémontais. Note de Émile Argand.

Italy—Rome—Historical. *J. and P. Asiatic S. Bengal* **2** (1906): 1–7. **Vidyābhūsana.**
Romaka, or the City of Rome, as mentioned in the Ancient Pali and Sanskrit works. By Mahāmahopādhyāya Satis Chandra Vidyābhūṣaṇa.

Italy—Sicily—Mud-volcanoes. *B.S.G. Italiana* **7** (1906): 198–224. **Crinò.**
Le Macalube di Girgenti in rapporto alla distribuzione geografica degli altri vulcani di fango. Del prof. dott. S. Crinò. *With Illustrations.*

Italy—Vesuvius. *Nature* **74** (1906): 7. **Sjögren.**
The Eruption of Vesuvius. By Dr. H. Sjögren.

North Sea—Fisheries. *J.S. Arts* **54** (1906): 401–409. **Garstang.**
The Fisheries of the North Sea, and the bearings of recent investigations upon the problems of supply. By Walter Garstang.

Russia—Northern Coasts. *Deutsche G. Blätter* **29** (1906): 25–32. **Sibiriakoff.**
Von Archangelsk zu Schiff zur Mündung der Petschora. Von A. Sibiriakoff.

South-East Europe. **Cora.**
Contribuzione all' etnografia della Croazia e della Serbia. Relazione del Prof.

Guido Cora. (Estratto dagli Atti del V. Congresso Geografico Italiano, tenuto in Napoli dal 3 a 11 Aprile, Volume 2°.) Naples, 1905. Size 10½ × 7, pp. 16. *Presented by the Author.*

Spain. *B.R.S.G. Madrid* **48** (1906): 81–104. **Abulfeda.**

Descripcion de España, por Ibrahim Abulfeda, traducida por D. Francisco Molla, con prólogo de D. Antonio Blázquez.

Spain. *La G., B.S.G. Paris* **13** (1906): 325–327. **Briet.**

Les Défilés du Haut-Aragon. Par Lucien Briet.

Spain. *B.R.S.G. Madrid* **48** (1906): 105–132. **Vergara.**

Refranes y cantares geográficos de España. Conferencia de D. Gabriel Maria Vergara.

On popular sayings and rhymes relating to geographical features.

Spain—Asturias. *B.R.S.G. Madrid* **46** (1904): 316–324. **Sela.**

La Cuenca del Nalón en Asturias. Por B. Aniceto Sela.

Spain—Cantabrian Mts. **Labrouche.**

Paul Labrouche. Les Pics d'Europe. Notes vieilles et neuves. Pau, 1906. Size 8½ × 5½, pp. 16. *Presented by the Author.*

Spain—Geology. *C. Rd.* **142** (1906): 752–755. **Depéret and Vidal.**

Sur le basin oligocène de l'Ebre et l'histoire tertiaire de l'Espagne. Note de C. Depéret et L. Vidal.

Sweden—Norrbotten—Shore-lines. **Sjögren.**

Marina Gränsen i Kalix- och Tornedalarna. Af Otto Sjögren. (Meddelanden från Upsala Universitets Mineralogisk-Geologiska Institution, 29.) Stockholm, 1906. Size 8½ × 5½, pp. 14. *Map and Illustrations.*

Switzerland. *Quarterly J. Geol. S.* **62** (1906): 165–194. **Garwood.**

The Tarns of the Canton Ticino (Switzerland). By Prof. E. J. Garwood. *With Maps and Plates.*

Noticed in the Monthly Record (August, p. 177).

Switzerland—Railways. *Questions Dipl.* **21** (1906): 522–535. **Girardin.**

Les projets Suisses. Voies nouvelles et raccourcis. Par P. Girardin. *With Maps.*

Turkey. *Petermanns M.* **52** (1906): 37–38. **Ischirkoff and Kassner.**

Der Devna-See. Morphometrische Bemerkungen von Prof. Dr. A. Ischirkoff, Deutsch bearbeitet von Prof. Dr. C. Kassner. *With Map.*

United Kingdom. *C. Rd.* **142** (1906): 555–559. **Baillaud and Mathias.**

Sur la Carte magnétique des Iles Britanniques. Par B. Baillaud et E. Mathias.

ASIA.

Central Asia. *Petermanns M.* **52** (1906): 41–43. **Friederichsen.**

Nachrichten von einer Reise W. A. Obrutschews im Gebiet des Tarbagatai (Sommer 1905). Von Dr. M. Friederichsen. [See August number, p. 180.]

Central Asia—Tarim. *B. American G.S.* **38** (1906): 91–96. **Huntington.**

The Border Belts of the Tarim Basin. By Ellsworth Huntingdon.

China—Geology. *J. Tōkyō G.S.* **17** (1905): 303–315, 475–492. **Ogawa.**

The Cambrian Formation of North China. By Takudzi Ogawa. *With Illustrations.* [In Japanese.]

China—Sechuan. **Kingsmill.**

The Shanghai Society of Engineers and Architects. 1905–1906. Eastern Szechwan: its Structure and Communications. By Thos. W. Kingsmill. Shanghai, 1906. Size 8½ × 5½, pp. 24.

China—Sechuan. **Legendre.**

Le Far-West Chinois. Deux Années au Setchouen. Récit de Voyage, Étude géographique, sociale et économique par le Dr. A. F. Legendre. Paris: Plon-Nourrit et Cie., 1905. Size 7½ × 5, pp. xvi. and 546. *Map and Illustrations. Price 5 fr. Presented by the Publishers.*

Dr. Legendre's travels were referred to in vol. 25, p. 211.

Chinese Empire—Tibet. *P. Zoolog. S.* 1905, ii. (1906): 302–308. **Bonhote.**
On a Collection of Mammals brought home by the Tibet Frontier Commission. By J. Lewis Bonhote.

Chinese Empire—Tibet. **Duncan.**
A Summer Ride through Western Tibet. By Jane E. Duncan. London: Smith, Elder & Co., 1906. Size 9 × 6, pp. xviii. and 342. *Map and Illustrations. Price* 14*s. net. Presented by the Publishers.* [To be reviewed.]

French Indo-China. *La G., B.S.G. Paris* **13** (1906): 322–323. **Madrolle.**
La population de l'Indo-Chine. Par Cl. Madrolle.

India—Burma. ———
The Burma Route Book. Part iii. Routes in Western Burma. Compiled in the Intelligence Branch, Quarter-Master General's Department in India, 1905. Size 13½ × 8½, pp. 200. *Map. Presented by the Intelligence Branch, Quarter-Master General's Dept., Simla.*

India—Languages. *J.S. Arts* **54** (1906): 581–600. **Grierson.**
The Languages of India and the Linguistic Survey. By Dr. G. A. Grierson.

Japan—Formosa. [**Crowe.**]
Japan. Report on the Gold Mines of Formosa. (Diplomatic and Consular Reports, Miscellaneous Series, No. 649.) London, 1906. Size 9½ × 6, pp. 10. *Price* 4*d.*

Korea. *J. Tōkyō G.S.* **17** (1905): 451–457, 550–563. **Sugiyama.**
Agriculture and Forestry in Korea. By Kiyotoshi Sugiyama. [In Japanese.]

Malay Archipelago—Ceram. **Sachse.**
Ts. K. Ned. Aard. Genoots. Amsterdam **23** (1906): 439–450.
Toelichtingen op de schetskaart van de afdeelingen Wahaï en West-Seran op het eiland Seran. Door F. J. P. Sachse. *With Maps and Illustrations.*

Malay Archipelago—Sumatra. **Baren.**
Ts. K. Ned. Aard. Genoots. Amsterdam **23** (1906): 564.
Over de geologische gesteldheid van Noord-Sumatra. Door J. van Baren.

Malay Peninsula—Flora. **King and Gamble.**
J. and P. Asiatic S. Bengal **1**, *Extra Number* (1905): pp. 386.
Materials for a Flora of the Malayan Peninsula, Nos. 16, 17, and 18. By Sir George King, K.C.I.E., etc., and J. Sykes Gamble, C.I.E., etc.

Russian Central Asia. *Izvestia Imp. Russ. G.S.* **40** (1904): 600–608. **Zalesski.**
Short account of the chronometrical expedition to the Southern shores of Lake Balkhash and the Karatal and Ili Rivers, 1903. By P. K. Zalesski. [In Russian.]

Russian Central Asia—Lake Balkhash. **Berg.**
Izvestia Imp. Russ. G.S. **40** (1904): 584–599.
Preliminary Report on the exploration of Lake Balkhash. By L. S. Berg. [In Russian.] *With Map and Illustrations.*

Sakhalin. *J. Tōkyō G.S.* **17** (1905): 584–589. **Ogawa.**
On the Renaming of Karafuto. By Takudzi Ogawa. [In Japanese.]

Sakhalin—Historical. *J. Tōkyō G.S.* **17** (1905): 538–549, 638–645. **Yoshida.**
Karafuto (Saghalien) under Prince Matsumae, 1688–1703. By Tōgo Yōshida. [In Japanese.]

Turkey—Arabia. *Blackwood's Mag.* **179** (1906): 597–617. [**Buxton.**]
A Journey to Sanaa. *With Sketch-map.*
The journey was made by Mr. Leland Buxton in company with a friend.

AFRICA.

Algeria. *Ann. G.* **15** (1906): 152–165. **Bernard and Lacroix.**
L'évolution du nomadisme en Algérie. Par A. Bernard et N. Lacroix.

Algerian Sahara. **Poirmeur.**
Renseignements Col., Comité Afrique Française (1906): 17–43, 96–110.
La région du Guir-Zousfana. Par le Lieutenant Poirmeur. *With Maps and Illustrations.*

Cape Colony—Historical. **Leibbrandt.**

Precis of the Archives of the Cape of Good Hope. Letters received, 1695–1708. By H. C. V. Leibbrandt. (1896; pp. 474); Letters despatched, 1696–1708. (1896; pp. 398.) December, 1651–May, 1662. Reibeeck's Journal, etc., 3 parts. (1897; pp. [part i.] vi. and 256; [part ii.] 210; and [part iii.] 350 and xxiv.; *portraits.*) The Defence of Willem Adriaan van der Stel. (1897; pp. 198; *illustration.*) Resolutiën van den Commandeur en Raden van het Fort de Goede Hoop, 1652–1662. (1898; pp. 188); Letters and Documents received, 1649–1662. 2 parts. (1898-99; pp. [part i.] iv. and 326; [part ii.] 522.) Letters despatched from the Cape, 1652–1662. 3 vols. (1900; pp. [vol. 1] iv. and 422; [vol. 2] 346; and [vol. 3] 482; *plates.*) Journal, 1662–1670. (1901; pp. 344.) The same, 1671–1674, and 1676. (1902; pp. 308.) Requesten (Memorials); 1715–1806. Vol. 1 A–E. (1905; pp. vi. and 440.) Cape Town. Size 9½ × 6. *Presented by the Government of Cape Colony.*

Cape Colony—Historical. **Theal.**

Records of the Cape Colony, from February, 1793, to April, 1831. Copied for the Cape Government, from the Manuscript Documents in the Public Record Office, London. By George McCall Theal, LL.D. Vols. **1–35**, and vol. **36**.—Register of the Contents of vols. 1–35. [Vols. **5**, **10**, **15**, **20**, **25**, **30**, and **35**, index-volumes.] Printed for the Government of the Cape Colony, 1897–1905. Size 9 × 6. *Maps, Plans, and Illustrations. Presented by the Government of Cape Colony.*

Central Africa—Ruwenzori. *B.S.G. Italiana* **7** (1906): 354–365. **Revelli.**

Il Runssóro (Ruvenzori) secondo le esplorazioni (1904) del dott. J. J. David. Nota del prof. P. Revelli.

See notes in vol. **24**, p. 348, vol. **25**, p. 93. Dr. David's angular measurements placed the height of the three highest summits (known collectively to the natives, he says, as Kokora) between 17,700 and 18,000 feet.

Central Africa—Zoology. *P. Zoolog. S.*, 1905, II. (1906): 309–310. **Lönnberg.**

Notes on the Geographical Distribution of the Okapi. By Dr. E. Lönnberg.

Central Africa—Zoology. *Nature* **74** (1906): 88. ———

The Haunts of the Okapi.

Gives information obtained by the Alexander-Gosling expedition (see *ante*, p. 181).

Congo State—Welle. *Mouvement G.* **23** (1906): 163–164. **Lemaire.**

Sur l'Uele, extrait du journal de route de la mission scientifique Congo-Nil. Par Commt. Lemaire.

East Africa—Masai. **Kaiser.**

Rassenbiologische Betrachtungen über das Masai-Volk. Von Alfred Kaiser. (Sonderdruck (nicht im Handel) aus dem Archiv für Rassen- und Gesellschafts-Biologie. 3. Jahrg. 2. Heft. März-April 1906.) Berlin. Size 10 × 7, pp. 201–226. *Illustrations. Presented by the Author.*

French Congo. *Renseignements Col., Comité Afrique Française* (1906): 77–89. ———

La réorganisation du Congo Français; décrets du 11 février 1906 et discussion à la Chambre des députés.

Cf. note in vol. **27**, p. 406.

French Sudan. *Ann. G.* **15** (1906): 177–180. **Desplagnes.**

La région du moyen Niger. Par le lieutenant L. Desplagnes. *With Illustrations.*

German South-West Africa. *Z. Kolonialpolitik*, etc., **8** (1906): 125–128. **Gessert.**

Ueber rationelle Bewässerung in D.-S.-W.-Afrika. Saatdamm oder Talsperre? Von Ferdinand Gessert.

Kamerun. *Deutsch. Kolonialblatt* **17** (1906): 235–241. **Glauning.**

Bericht des Hauptmanns Glauning über seine Reise in den Nordbezirk.

Madagascar. ———

Gouvernement Général de Madagascar et Dépendances. Statistiques Générales. [1904.] Situation de la Colonie au 1er Janvier 1905. Population, Administration, Agriculture, Élevage, Industrie, Commerce. Melun: Imprimerie Administrative, 1906. Size 14 × 10½, pp. 262. *Presented by the Office Colonial, Paris.*

Morocco. *Ann. G.* **15** (1906): 133–151. **Gentil.**

Contribution à la géologie et à la géographie physique du Maroc. Par Louis Gentil. *With Illustrations.*

Morocco—Atlas Mountains. *C. Rd.* **142** (1906): 811–814. **Gentil.**
Contribution à la géographie physique de l'Atlas marocain. Note de Louis Gentil.

Nigeria. **Dunstan.**
Northern Nigeria: First Report on the Results of the Mineral Survey of Northern Nigeria, 1904–5. (No. I. of Series.) By Prof. Wyndham Dunstan, F.R.S. Colonial Reports, Miscellaneous, No. 32, 1906. Size 10 × 6, pp. 24. *Price* 1½*d.*

Nigeria. **Dunstan.**
Southern Nigeria. Reports on the Mineral Survey of Southern Nigeria for 1903–4 and 1904–5. By Prof. Wyndham Dunstan, F.R.S. Colonial Reports, Miscellaneous, No. 33, 1906. Size 10 × 6, pp. 34. *Price* 2½*d.*

Nile Basin—Meteorology. **Lyons.**
Ministry of Finance. Survey Department, Egypt. The Rains of the Nile Basin in 1905. By Captain H. G. Lyons. Cairo, 1906. Size 11 × 8, pp. 40. *Maps and Diagrams.*

Portuguese East Africa—Cotton and Rubber. ——
A Companhia de Moçambique, na Exposição da Sociedade de Geographia de Lisboa. Memoria ácerca de Algodão e Borracha. Lisboa: Typ. Adolpho de Mendonça, 1906. Size 10½ × 7½, pp. 130. *Maps and Illustrations.*

Portuguese West Africa—San Thomé. **Chevalier.**
La G., B.S.G. Paris **13** (1906): 257–274.
L'île de San-Thomé. Par A. Chevalier. *With Map.*

Rhodesia—Geodetic Survey. **Simms.**
Rhodesia. Geodetic Survey of South Africa. Vol. 3. Report on the Geodetic Survey of part of Southern Rhodesia. Executed by Mr. Alexander Simms, Government Surveyor, under the direction of Sir David Gill, K.C.B., etc. Cape Town, 1905. Size 13 × 8½, pp. xiv. and 146. *Plans. Presented by H.M. Astronomer, Cape Town.*

Sahara. *La G., B.S.G. Paris* **13** (1906): 304–308. **Chudeau.**
Exploration de M. R. Chudeau dans le Sahara. *With Plans.*
See note in the May number (p. 505).

NORTH AMERICA.

Canada. ——
Annual Report of the Department of the Interior for 1903–1904. Ottawa, 1905. Size 10 × 6½. *Illustrations.*

Canada—Discovery. **Jalk and Others.**
Acadiensis. Edited by David Russell Jack. A Quarterly devoted to the Interests of the Maritime Provinces of Canada. Vol. 4. Nos. 3–4, July–October, 1904. Special Champlain Number. Size 10 × 6½, pp. 173–362. *Maps and Illustrations. Presented.*
A series of papers on subjects connected with Champlain's explorations in Eastern Canada, on the occasion of their tercentenary in 1904.

Canada—New Brunswick. *B. Nat. Hist. S. New Brunswick* **5** (1906): 399–405. **Bailey.**
Remarks on the Hydrography of New Brunswick. By J. W. Bailey. *With Maps.*

Canada—New Brunswick. *B. Nat. Hist. S. New Brunswick* **5** (1906): 409–474. **Ganong.**
Notes on the Natural History and Physiography of New Brunswick, Nos. 89–100. By W. F. Ganong. *With Maps and Illustration.*

Canada—Quebec. *American J. of Sc.* **21** (1906): 196–205. **Wilson.**
On the glaciation of Orford and Sutton Mountains, Quebec. By Alfred W. G. Wilson. *With Sketch-map and Illustrations.*

Mexico—Yucatan. **Southworth.**
Yucatan Ilustrado. El Estado de Yucatan. Su Descripción, Gobierno, Historia, Comercio é Industrias. En Español é Inglés. Tomo viii. Agosto, 1905. Publicado . . . por J. R. Southworth. 1905. Size 13½ × 10, pp. 80. *Illustrations. Presented by S. Hardman, Esq.*

North America—Ethnology. *B.G.S. Philadelphia* **4** (1906): 25–41. **Harshberger.**
Phytogeographic Influences in the Arts and Industries of American Aborigines. By Dr. J. W. Harshberger. *With Map.*

North America—History of Geology. **Merrill.**

Contributions to the History of American Geology. By G. P. Merrill. (Annual Report, Smithsonian Institution, 1904. Report of the U.S. National Museum.) Washington, 1906. Size 9½ × 6½, pp. 189-733. *Maps, Portraits, and Illustrations.*

United States. *Science* **23** (1906): 583-584. **Farnsworth.**

On the origin of the small mounds of the Lower Mississippi Valley and Texas. By P. J. Farnsworth.

The writer considers these mounds to be heaps of soil raised by falling trees.

United States. *B. Museum Comparative Zoology, Geol. Ser.* **8** (1906): 59-87. **Mansfield.**

Post-Pleistocene drainage modifications in the Black Hills and Bighorn Mountains. By G. R. Mansfield. *With Maps and Illustrations.*

See note, *ante*, p. 403.

United States—Arizona. **Barringer.**

P.A. Nat. Sc. Philadelphia **57**, 1905 (1906): 861-886.

Coon Mountain and its Crater. By D. M. Barringer.

United States—Arizona. **Tilghman.**

P.A. Nat. Sc. Philadelphia **57**, 1905 (1906): 887-914.

Coon Butte, Arizona. By B. C. Tilghman.

United States—California. *Nature* **73** (1906): 608-610. **Davison.**

The San Francisco Earthquake of April 18. By Dr. C. Davison.

United States—Early Travels. **Thwaites.**

Early Western Travels: 1748-1846. Edited by Dr. Reuben Gold Thwaites. Vol. **19**—Ogden's Letters from the West, 1821-1823; Bullock's Journey from New Orleans to New York, 1827; and Part i. of Gregg's Commerce of the Prairies, 1831-1839. Vol. **20**—Part ii. of Gregg's Commerce of the Prairies, 1831-1839. Vol. **21**—Wyeth's Oregon, or a Short History of a Long Journey, 1832; and Townsend's Narrative of a Journey across the Rocky Mountains, 1834. Vols. **22**, **23**, and **24**—Maximilian Prince of Wied's Travels in the Interior of North America, 1832-1834. Cleveland, Ohio, (19-21) 1905, (22-24) 1906. Size 9½ × 6½. *Maps, Plans, and Illustrations. Price* 16*s.* 8*d. per vol.*

United States—Florida. *National G. Mag.* **17** (1906): 5-16. **Gifford.**

The Florida Keys. By John Gifford. *With Map and Illustrations.*

United States—Irrigation. *National G. Mag.* **17** (1906): 82-100. **Blanchard.**

Winning the West: an Account of the marvelous progress of our Reclamation Service in Reclaiming the Desert. By C. J. Blanchard. *With Illustrations.*

United States—Nashville. *J. School G.* **5** (1901): 201-207. **Wright.**

Nashville: its Early History and the cause of its growth and prosperity. By Caroline McL. Wright.

United States—New York. *J. Geology* **14** (1906): 18-21. **Tarr.**

Glacial Erosion in the Finger Lake Region of Central New York. By Ralph S. Tarr.

United States—Pennsylvania. **Tower.**

B.G.S. Philadelphia **4** (1906): No. 2, 9-28; No. 3, 1-24.

Regional and Economic Geography of Pennsylvania. Part i.—Physiography: The South-East Province; the Central Province. By Walter S. Tower. *Maps.*

United States—Turpentine. **Bell.**

Turpentine Industry in the United States. Foreign Office, Miscellaneous, No. 647, 1906. Size 10 × 6¼, pp. 18. *Price* 1½*d.*

CENTRAL AND SOUTH AMERICA.

Argentine Republic. **Martinez.**

Recensement Général de la population, de l'édification, du commerce et de l'industrie de la Ville de Buénos-Ayres effectué les 11 et 18 Septembre 1904 sous l'administration de M. Albert Casares, par Albert B. Martinez. Buénos-Ayres, 1906. Size 11 × 7½, pp. clxvi. and 558. *Plan and Illust. Presented by the Direction of the Census.*

Bolivia. *Petermanns M.* **52** (1906): 1-13, 25-32. **Hoek and Steinmann.**

Erläuterung zur Routenkarte der Expedition Steinmann, Hoek, v. Bistram in den Anden von Bolivien 1903-04. Von Dr. Henry Hoek und Prof. Dr. Gustav Steinmann. *With Maps.*

Panama Canal. *National G. Mag.* **17** (1906): 55–68. **Shonts.**

The Panama Canal. By Hon. T. P. Shonts. *With Illustrations.*

West Indies.

West Indies. Report on the Working of the Imperial Department of Agriculture for the West Indies. Colonial Reports, Miscellaneous, No. 36, 1906. Size 10 × 6 pp. xxxvi. and 290. *Price* 1*s.* 4*d.*

AUSTRALASIA AND PACIFIC ISLANDS.

Australia. *J.R. Colonial I.* **37** (1905-06): 326-364. **James.**

Australian Immigration. By Walter James.

British New Guinea. **Hunt.**

British New Guinea. Report by Mr. Atlee Hunt. [Melbourne], 1905. Size 13½ × 8½, pp. 28. *Map.*

Noticed in the May number (p. 507).

Pacific Ocean. *Terrestrial Magnetism* **11** (1906): 52. **Bauer.**

Magnetic Survey of the Pacific Ocean. Second Cruise. By L. A. Bauer. *Plate.*

See August number, p. 184, where the vessel's name should read as *Galilee.*

POLAR REGIONS.

Antarctic. **Arctowski.**

Projekt einer systematischen Erforschung des Südpolarkontinents. Von H. Arctowski. Kattowitz u. Leipzig: Carl Swinna, [1905]. Size 9 × 6, pp. 34. *Map and Illustrations.*

Antarctic—Scottish Expedition. *Scottish G. Mag.* **22** (1906): 252–272. **Mossman.**

Some Meteorological Results of the Scottish National Antarctic Expedition. By R. C. Mossman. *With Diagrams.*

Antarctic—Swedish Expedition. **Nordenskjöld.**

Wissenschaftliche Ergebnisse der Schwedischen Südpolar-Expedition 1901–1903, unter Leitung von Dr. Otto Nordenskjöld. Band I. Lief. 3 und 4, Die Gesundheits- und Krankenpflege während der Schwedischen Südpolar-Expedition, Oktober 1901—Januar 1904; Ueber "Präserven-Krankheiten," von Erik Ekelöf (pp. 54). Band III. Lief. 1, Ueber die alttertiären Vertebraten der Seymourinsel, von Carl Wiman (pp. 38). Band IV. Lief. 1, Hepaticæ, gesammelt von C. Skottsberg während der Schwedischen Südpolarexpeditionen 1901–1903, bearbeitet von F. Stephani (pp. 12); Lief. 2, Feuerländische Blüten, Einige Aufzeichnungen und Beobachtungen, von C. Skottsberg (pp. 176); Lief. 3, Die Gefässpflanzen Südgeorgiens, von C. Skottsberg (pp. 12); Lief. 4, Zur Flora des Feuerlandes, Floristische Beobachtungen über Gefässpflanzen, gesammelt in den Jahren 1902 und 1903, von C. Skottsberg (pp. 42). Band V. Lief 1, Brutpflege bei Antedon hirsuta Carpenter, von K. A. Andersson (pp. 8); Lief. 2, Das höhere Tierleben im antarktischen Gebiete, von K. A. Andersson (pp. 58); Lief. 3, Die Oligochaeten der Schwedischen Südpolar-Expedition, von Dr. W. Michaelsen (pp. 12); Lief. 4, Cladoceren und Copepoden aus antarktischen und subantarktischen Binnengewässern gesammelt von der Schwedischen antarktischen Expedition 1901–1903, bearbeitet von Dr. S. Ekman (pp. 40); Lief. 5, Die Vögel der Schwedischen Südpolar-Expedition, von E. Lönnberg (pp. 10); Lief. 6, The Fishes of the Swedish South Polar Expedition, by E. Lönnberg (pp. 70); Lief. 7, Anomoura und Brachyura der Schwedischen Südpolar-Expedition, von T. Lagerberg (pp. 40); Lief. 8, Hydroiden aus antarktischen und subantarktischen Meeren, gesammelt von der Schwedischen Südpolarexpedition, bearbeitet von Dr. E. Jäderholm (pp. 42). Stockholm, 1905–6. Size 11 × 8½. *Maps and Plates.*

Arctic. *B.S.R. Belge G.* **30** (1906): 98–116. **Bénard.**

Projet d'expédition océanographique double à travers le bassin arctique. Par C. Bénard.

Arctic—Meteorology. *Met. Z.* **23** (1906): 97-114. **Hann.**

Meteorologie des Nordpolarbassins. Ergebnisse der norwegischen Nordpolarexpedition unter Fridtjof Nansen 1893–96. Referat von J. Hann. *With Diagrams.*

Spitzbergen.

Missions scientifiques pour la Mesure d'un Arc de Méridien au Spitzberg, entreprises en 1899–1902 sous les auspices des Gouvernements Suédois et Russe.

Mission Suédoise. Tome I. Astronomie et Géodésie; II^e Sec., Travaux géodésiques. B. Mesure des angles horizontaux et verticaux (pp. 100); V^e Sec., Marégraphe, Nivellement (pp. 60). Tome II. Physique terrestre, Météorologie, Histoire naturelle; VII^e Sec., Magnétisme terrestre. A. Levée magnétique du Spitzberg (pp. 56); VIII^e Sec., Météorologie. A. Observations régulières à la station d'hivernage (pp. 222). B. Radiation Solaire (pp. 60); B^i. Etats des glaces et de la neige (pp. 58); B^ii. Forme et grandeur des cristaux de neige (pp. 20); B^iii. Observations météorologiques faites à la station de montagne (pp. 20); B^iv. Observations météorologiques et hydrographiques faites en mer 1899 (pp. 28); B^v. Observations météorologiques en mer 1901 (pp. 48). C. Aurores boréales (pp. 120); X^e Sec., Botanique (pp. 64). Stockholm, 1903–1906. Size 12½ × 10. *Illustrations. Presented by the Commission Royale du Spitzberg.*

MATHEMATICAL GEOGRAPHY.

Cartography. **Frischauf.**

Die Abbildungslehre und deren Anwendung auf Kartographie und Geodäsie. Von Dr. J. Frischauf. (Sonderabdruck aus der Zeitschrift für Mathematischen und Naturwissenschaftlichen Unterricht, 36. Jahrg.) Leipzig: B. G. Teubner, 1905. Size 10 × 6½, pp. 32. *Price* 1*m. Presented by the Publisher.*

Navigation. **Purey-Cust.**

Sumner's Method. By Captain H. E. Purey-Cust. Portsmouth: Griffin & Co., 1906. Size 8¼ × 5½, pp. 24.

Navigation.

Notes bearing on the Navigation of H.M. Ships. Fifth edition. London: J. D. Potter, 1906. Size 10 × 6, pp. 36. *Price* 2*d. Presented by the Admiralty.*

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Geological History. *Ann. G.* **15** (1906): 97–114. **Lapparent.**

Sur de nouvelles mappemondes paléogéographiques. Par A. de Lapparent. *With Maps.*

An attempt to reconstruct the geography of former ages, illustrated by a series of maps.

Geomorphology. *Sitzb. K.B.A.W. München*, 1905 (1906): 477–494. **Günther.**

Neue Beiträge zur Theorie der Erosionsfiguren. Von S. Günther. *With Illustrations.*

Geomorphology. *Riv. G. Italiana* **13** (1906): 137–141. **Martelli.**

Di un nuovo ordinamento sistematico delle forme elementari della superficie terrestre. A. Martelli.

Discusses a scheme of classification suggested by A. Issel.

Geomorphology. **Rühl.**

Beiträge zur Kenntnis der morphologischen Wirksamkeit der Meeresströmungen. Von Dr. Alfred Rühl. (Veröffentlichungen des Instituts für Meereskunde und des Geographischen Instituts an der Universität Berlin, herausgegeben von . . . Ferdinand Frhr. von Richthofen, Heft 8, Februar 1906.) Berlin: E. S. Mittler und Sohn. Size 10½ × 7½, pp. 44.

Glaciers. *Petermanns M.* **52** (1906): 59–64. **Hess.**

Winterwasser der Gletscherbäche. Von Prof. Dr. H. Hess.

Limnology. *P.R.S. Edinburgh* **26** (1906): 107–115. **Collet and Johnston.**

On the Formation of certain Lakes in the Highlands. By Dr. Léon W. Collet and Dr. T. N. Johnston. With a Note on Two Rock Basins in the Alps, by Dr. Léon W. Collet. *With Maps and Illustrations.*

Limnology. *Petermanns M.* **52** (1906): 40–41. **Halbfass.**

Zu der Mitteilung von Dr. Otto Frhr. v.u.z. Aufsess "Untersuchungen über die Erhöhung der Temperatur am Grunde der Seen." Von Prof. Dr. W. Halbfass.

Throws doubt on the conclusions of the writer in question (cf. *Journal*, vol. **27**, 408).

Limnology—Seiches. *P.R.S. Edinburgh* **26**, 1905-6 (1906): 142–156. **White and Watson.**

Some Experimental Results in connection with the Hydrodynamical Theory of Seiches. By P. White and W. Watson. *With Illustrations.*

Meteorology. *Quarterly J.R. Met. S.* **32** (1906): 141–150. **Dallas.**
Brief Discussion of the General Features of the Pressure and Wind Conditions over the Trades-Monsoon Area. By W. L. Dallas. *With Diagrams.*

Meteorology. **Rotch and Bort.**
The Meteorological Conditions above the Tropical North Atlantic. By A. L. Rotch and L. Teisserenc de Bort. (*Meteorologische Zeitschrift*, Hann-Band, pp. 270–275.) Braunschweig: F. Vieweg und Sohn, 1906. Size 12 × 8. *Diagrams.*

Meteorology—Instrument. *Quarterly J.R. Met. S.* **32** (1906): 11–14. **Newton.**
The Aquameter. By Dr. W. B. Newton. *With Illustration.*
On a new instrument for measuring the amount of moisture contained in air.

Meteorology—Methods. *Quarterly J.R. Met. S.* **32** (1906): 47–52. **Ball.**
A Rapid Method of finding the Elastic Force of Aqueous Vapour and the Relative Humidity from Dry-bulb and Wet-bulb Thermometer Readings. By Dr. John Ball. *With Diagrams.*

Meteorology—Methods. *Quarterly J.R. Met. S.* **32** (1906): 15–28. **Simpson.**
An attempt to fly Kites for Meteorological Purposes from the Mission Ship attached to a Deep-sea Fishing Fleet in the North Sea. By G. C. Simpson. *With Diagram and Illustration.*

Meteorology—Snow. **Jansson.**
Om värmeledningsformågan hos Snö. . . . Af Martin Jansson. Upsala, 1904. Size 9 × 6, pp. 34. *Illustrations.*
Discusses the conductivity of snow.

Meteorology—Temperature. *Petermanns M.* **52** (1906): 32–36. **Hopfner.**
Die thermischen Anomalien auf der Erdoberfläche. Von Dr. F. Hopfner. *With Maps.*
See August number, p. 184.

Meteorology—Temperature. *Petermanns M.* **52** (1906): 37. **Supan.**
Der jährliche Gang der Temperatur auf der Erdoberfläche. Von Prof. A. Supan. *With Diagram.*

Meteorology—Temperature. **Woeikof.**
Die Verteilung und Akkumulation der Wärme in den Festländern und Gewässern der Erde. Von A. Woeikof. (*Meteorologische Zeitschrift*, Hann-Band, pp. 186–208.) Braunschweig: F. Vieweg und Sohn, 1906. Size 12 × 8.

Meteorology—Winds. **Abbe.**
The Trade Winds and the Doldrums. By Prof. Cleveland Abbe. (*Meteorologische Zeitschrift*, Hann-Band, pp. 254–260.) Braunschweig: F. Vieweg und Sohn, 1906. Size 12 × 8. *Illustrations.*

Meteorology—Winds. **Hepworth.**
The Relation between Pressure, Temperature, and Air Circulation over the South Atlantic Ocean. Notes with reference to the Monthly Wind-Charts of the South Atlantic Ocean, prepared in the Meteorological Office and published by the Hydrographic Office, January, 1904. By M. W. Campbell Hepworth. London, 1905. Size 10 × 6, pp. 12. *Charts.*

Meteorology—Winds. **Rotch.**
Proof of the existence of the upper anti-trade and the meteorological conditions at lesser heights in the Northern Tropics. By A. Lawrence Rotch. Size 9½ × 6, pp. 4. *Presented by the Author.*

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Historical—Charts. *B.S.G. Italiana* **7** (1906): 263–264. ———
Portolani esistenti nella Biblioteca dell' Accademia Etrusca di Cortona.
Four of these portolani had not previously been described. The dates seem to vary from the fifteenth to the eighteenth centuries.

Historical—Quiros' Voyage. *B.S.R.G. Madrid* **46** (1904): 390–394. [**Collingridge.**]
El Puerto de la Vera Cruz: Sobre la Identificación de los Descubrimentos de Queiroz en las Regiones de su Tierra Austrialia del Espíritu Santo.

Historical—Waldseemüller. *G.Z.* **12** (1906): 165. **Ravenstein.**
Die Waldseemüllerschen Karten. Von E. G. Ravenstein.
Criticism suggested by the Waldseemüller facsimiles.

BIOGRAPHY.

Borgonio. *Riv. G. Italiana* **13** (1906): 142–150. **Mori.**
Tomaso Borgonio e la sua opera cartografica. A. Mori.
Borgonio, a draughtsman and military engineer, born about 1630 or earlier, is best known for his map of Piedmont.

Carletti. *Riv. G. Italiana* **13** (1906): 65–84. **Mondaini.**
Francesco Carletti, mercante e viaggiatore fiorentino (1573?–1636). Appunti del Prof. G. Mondaini. *With Map.*

Richthofen. *Ts. K. Ned. Aard. Genoots. Amsterdam* **23** (1906): 542–559. **Kan.**
Ferdinand von Richthofen als Geograaf. Door Prof. Dr. C. M. Kan.

GENERAL.

Medical Geography. *B.S.G. Italiana* **7** (1906): 90–100. **Maranelli.**
Ancora a proposito della "Carta della Malaria." Nota dell dott. Prof. Carlo Maranelli.

Medical Geography. *B.G.S. Philadelphia* **4** (1906): 29–55. **Ward.**
The Hygiene of the Zones. By Robert De C. Ward.

Year-Book. **Klein.**
Jahrbuch der Astronomie und Geophysik. Herausgegeben von Prof. Dr. Hermann J. Klein. XVI. Jahrg, 1905. Leipzig: E. H. Mayer, 1906. Size 9 × 5½, pp. viii. and 368. *Illustrations.*

NEW MAPS.

By **E. A. REEVES**, *Map Curator*, **R.G.S.**

EUROPE.

British Isles. **Johnston.**
The British Isles. Scale 1:633,600 or 1 inch to 10 stat. miles. Edinburgh: W. & A. K. Johnston, 1906. *Price, mounted on rollers and varnished*, £1 1*s*. *Presented by the Publisher.*

Forms one of the publishers' Imperial Series of maps. It is bold in style, and intended for the walls of class-rooms. An attempt has been made to indicate hills by shading, but this is to a great extent obliterated by the unnecessarily deep colouring of the counties. The map measures 72 by 63 inches.

England and Wales. **Ordnance Survey.**
ORDNANCE SURVEY OF ENGLAND AND WALES:—Sheets published by the Director-General of the Ordnance Survey, Southampton, from August 1 to 31, 1906.

2 miles to 1 inch:—
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25 N.E. **Devonshire**, 17 S.W. (26 N.E. and 27 N.W.), 27 N.E., 43 S.W., 48 N.W., S.E., 66 S.E., 67 S.E., 76 S.E., 78 N.E., S.E., 80 S.E., 81 S.E., 89 S.W., 90 N.W., S.W., 91 N.W., N.E., S.W., 92 S.W., S.E., 100 N.E., 101 N.W., N.E., S.E., 102 N.E., 113 S.W., 116 (N.W. and N.E.). **Lincolnshire**, 77 N.E., 78 S.W., S.E., 79 S.W., 85 S.E., 86 N.W., N.E., S.E., 87 N.W., S.W., 89 S.E., 90 N.W., N.E., S.E., 95 S.E., 98 S.E., 99 S.E., 101 S.W., 109 S.W., S.E., 110 N.W., 114 N.W., 118 N.W., 119 N.W., 126 S.E., 127 N.W., N.E., 128 N.W., S.E., 129 S.W., 134 S.E., 135 N.E., S.W., 136 N.E. **Norfolk**, 5 S.E., 44 N.W., 57 S.E., 58 N.E., 70 N.W., 71 N.E., 82 S.E., 83 S.W., S.E., 89 N.E., 92 N.W., 93 N.W., 94 S.W., S.E., 95 S.W., 96 N.E., 97 N.E., S.W., 103 N.W., 105 N.W., N.E. **Suffolk**, 3 N.E., 10 S.E. **Warwickshire**, 21 N.E., S.E., 22 N.W., S.W., 26 S.W., 27 S.E., 29 N.W., S.W., 38 S.E., 39 N.E., S.W., 41 S.E., 43 S.E., 44 N.W., N.E., S.E., 46 N.E., S.E., 47 N.E., S.W., 49 N.E., 50 N.E., S.E., 52 S.W., S.E., 53 N.E., S.E., 55 N.W., N.E., 56 N.E., S.E., 57 S.E., 58 N.E., 59 N.W., N.E. 1*s. each.*

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(*E. Stanford, London Agent.*)

Germany. **K. Preussische Landesaufnahme.**

Karte des Deutschen Reiches. Herausgegeben von der Kartographischen Abteilung der Königlichen Preussische Landesaufnahme. Scale 1 : 100,000 or 1 inch to 1·6 stat. mile. Sheets (plain): 341, Jüterbog; 344, Guben; 369, Spremberg; (coloured) 320, Fürstenberg a. d. O.; 321, Crossen, a. d. O.; 370, Sorau; 371, Sprottau; 458, Altenkirchen. Berlin: K. Preussische Landesaufnahme, 1905–6. *Price* 1.50 *mark each sheet.*

Servia. **Adamovic.**

Pflanzengeographische Karte Serbiens. Von Prof. Dr. Lujo Adamovic. Scale 1 : 750,000 or 1 inch to 11·8 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1906, Tafel 13. Gotha: Justus Perthes, 1906. *Presented by the Publisher.*

An outline map of Servia, showing, by various tints of green, six different vegetation regions, which are designated as follows: Tiefland, Hügel, Submontane, Montane, Voralpine, Subalpine, and Alpine. In addition to the green tinting, red lines divide the vegetation into zones, and the character of the vegetation and the different kinds of trees and plants are shown by symbols. The map itself is a bare outline with few names. If a general idea of the altitude of the various regions could have been given by figures or some other means, it would have been an advantage. The map, accompanied by a short article by the author, appears in the August number of *Petermanns Mitteilungen.*

Sweden. **Sveriges Geologiska Undersökning.**

Sveriges Geologiska Undersökning. Ser. Aa. Scale 1 : 50,000 or 1·3 inch to a stat. mile. Sheets: 120, Falköping; 125, Tidaholm; 126, Ankarsrum; 130, Vadstena; 131, Gällö; 132, Hjo; 133, Vimmerby.—Ser. A1,a. Scale 1 : 200,000 or 1 inch to 3·1 stat. miles. Sheet 5, Karlskrona-Kalmar. Stockholm: Sveriges Geologiska Undersökning. *Presented by the Institut Royal Géologique de Suède.*

ASIA.

Hong Kong. **Topographical Section, General Staff.**

Map of Hong Kong and of the territory leased to Great Britain under the convention between Great Britain and China, signed at Pekin on June 9, 1898. Scale

1 : 84,480 or 1 inch to 1·3 stat. mile. London : Topographical Section, General Staff, War Office, 1905. *Price 2s. 6d. Presented by the Director of Military Operations.*

A good general map based upon the best material, including Mr. Tate's surveys of the Kunlun territory and the Admiralty charts. Hill work is shown by brown contours at 100-feet intervals. The boundary along the shores of Mirs bay and Deep bay is the high-water mark; it has not been surveyed, and, as laid down, can only be taken as provisional.

Turkey in Asia. **Auler.**

Die Hedschas-Bahn. Scale 1 : 3,000,000 or 1 inch to 47·3 stat. miles. *Petermanns Mitteilungen*, Ergänzungsheft No. 154, Tafel 1. Gotha : Justus Perthes, 1906. *Presented by the Publisher.*

AFRICA.

Cape of Good Hope. **Geological Commission, Cape Town.**

Geological map of the Colony of the Cape of Good Hope. Sheet 1. Scale 1 : 237,600 or 1 inch to 3·7 stat. miles. Cape Town : Geological Commission, 1906. *Presented by the Director of the Geological Survey of the Cape of Good Hope.*

This sheet includes the neighbourhood of Cape Town, Stellinbosch, Lady Grey, Robertson, and Napier. The map of which it forms part will give the results of the first attempt at a general geological survey of Cape Colony, and will be of considerable importance. It is clearly drawn and printed, the colours being carefully selected.

Egypt. **Survey Department, Cairo.**

Map of a portion of the Eastern Desert of Egypt. Scale 1 : 100,000 or 1 inch to 1·6 stat. mile. Sheets : 13 G, 13 H, 14 H, 15 H, 15 J, 16 J. Cairo : Survey Department, 1906. *Presented by the Director-General of the Survey Department, Cairo.*

The region of the eastern desert of Egypt represented by these sheets lies between the parallels of 23° 40′ N. and 25° 10′ N., and between the meridian of 34° E. long. and the Red sea coast. The whole of the area included within these latitudes and longitudes is not yet published, but the above are the more important sheets. Although a considerable amount of survey work has been completed by the Egyptian Survey Department, it is evident, from the many gaps on the sheets, that much still remains to be done; and it will be a great assistance to those whose duty it will be to fill in these blanks to have the triangulation points shown on this map, to which their work can be adjusted. These sheets are preliminary issues, and a note states that the final adjustment to the fixed trigonometrical points has not been made.

Egypt. **Survey Department, Cairo.**

Topographical map of the Giza Province. Scale 1 : 10,000 or 6·3 inches to a stat. mile. Sheets : N.E., 1-3, 1-4, 2-2, 2-3, 2-4, 3-1, 3-2, 3-3, 3-4, 3-5, 4-1, 4-2, 4-3, 4-4, 5-1, 5-2; N.W., 5-1, 6-2, 7-2, 7-3, 8-3, 8-4; S.E., 1-3, 1-4. Cairo : Survey Department, 1905–1906. *Presented by the Director-General of the Survey Department, Cairo.*

Kamerun. **Adams.**

Aufnahmen an der Batanga-Küste und im Lobe-Flussgebiet (Süd-Kamerun), 1905. Von Pater Gust. Alf. Adams. Scale 1 : 100,000 or 1 inch to 1·6 stat. mile. *Mitteilungen aus den deutschen Schutzgebieten*, Band xix. 1906. Berlin : E. S. Mittler & Son, 1906.

Togo. **Sprigade.**

Karte von Togo. Bearbeitet von P. Sprigade. Scale 1 : 200,000 or 1 inch to 3·1 stat. miles. Sheet D1, Kéte-Krátschi. *Mitteilungen aus den deutschen Schutzgebieten*, Band xix., 1906, Karte 5. Berlin : E. S. Mittler & Son, 1906.

AMERICA.

Panama. **Topographical Section, General Staff.**

Panama. Scale 1 : 1,000,000 or 1 inch to 15·8 stat. miles. London : Topographical Section, General Staff, War Office, 1906. *Price 2s. Presented by the Director of Military Operations.*

This map has been compiled from the best available material, but most of this is very approximate. The only part that has been properly surveyed is the Canal zone, which has been leased to the United States in perpetuity.

AUSTRALIA.

Queensland. **Fox and Dunstan.**

Geological sketch-map of Queensland, showing mineral localities. Prepared under the supervision of B. Dunstan, F.G.S., Acting Government Geologist, and compiled by H. W. Fox. Scale 1:2,534,400 or 1 inch to 40 stat. miles. Brisbane: Geological Survey Office, 1905. *Presented by the Geological Survey of Queensland.*

A new edition of a useful general geological map which, in addition to the usual colouring for the various formations, indicates by bold red circles and letters the distribution of minerals.

ATLANTIC OCEAN.

Canary Islands. **Sapper.**

Kartenskizze von Lanzarote (Canarische Inseln). Nach der Seekarte von Arlett, nach O. Simony und eigenen Aufnahmen, entworfen von Karl Sapper, 1906. Scale 1:150,000 or 1 inch to 2·3 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1906, Tafel 12. Gotha: Justus Perthes, 1906. *Presented by the Publisher.*

GENERAL.

World. **Bartholomew.**

Atlas of the World's Commerce. A new series of maps, with descriptive text and diagrams, showing products, imports, commercial conditions, and economic statistics of the countries of the world. Compiled from the latest official returns at the Edinburgh Geographical Institute, and edited by J. G. Bartholomew, F.R.G.S., F.R.S.E. Part vii. London: George Newnes, Limited, [1906]. *Price 6d. net. each part. Presented by the Publisher.*

This part contains the following plates: Nos.: 49, Dominion of Canada, industrial, chief imports and exports; 50, 51, North America, commercial routes and vegetation; 52, United States, industrial; 53, United States, industrial, chief imports and exports; 54, 55, South America, commercial routes and vegetation; 56, West Indies. In addition to these maps and diagrams there is the usual continuation of the alphabetical List of Commodities of Commerce, extending from "Palma Christi" to "Rags."

World. **Stieler.**

Neunten, von Grund aus neubearbeiteten und neugestochenen Auflage von Stieler's Hand Atlas. 100 Karten auf 200 Seiten mit 162 Nebenkarten in Kupferstich und einem alphabetischen Verzeichnis aller im Atlas vorkommenden Namen (ungefähr 240,000 Namen enthaltend) herausgegeben von Justus Perthes'. Geographischer Anstalt in Gotha. Lieferungen 13-18. Gotha: Justus Perthes, 1906. *Price 60 pf. each part.*

CHARTS.

Admiralty Charts. **Hydrographic Department, Admiralty.**

Charts and Plans published by the Hydrographic Department, Admiralty, during July, 1906. *Presented by the Hydrographer, Admiralty.*

No.	Inches.	
3580 m	= 6·8	Wales, west coast:—Fishguard bay. 2*s.*
3494 m	= 1·42	Norway, west coast:—Giaeslingerne light to Dolm sund, including Folden fiord. 3*s.*
3465 m	= 1·42	Baltic, Little Belt:—Trælle nes to Aarö sund. 3*s.*
3579 m	= 0·8, 0·89, 10·00, 1·78, 1·00	South Atlantic ocean:—South Georgia. Plans:—Royal bay, King Edward cove, Moltke harbour, sketch of Cumberland bay.
3573 m	= 7·34	Plans on the coast of Chile:—Antofagasta, Hornos cove, Coloso cove. 2*s.*
591 m	= 1·46	United States, west coast:—San Francisco harbour (*preliminary*). 3*s.*
27 m	= 3·1	Persian gulf:—Abu shahr (Bushire). 3*s.*
3574 m	= 1·8, 3·6	Malacca strait. Plans on the east coast of Sumatra:—Langsar bay, Langsar river entrance, Birim river entrance. 2*s.*
3283 m	= 3·63	Plans in the Philippine islands:—Salomague harbour and Lapog bay, Port Kurrimao, and Gan bay. 2*s.*

1288 m = {5·9 / 2·1} China:—Plans in the Yang tse Kiang, Chin Kiang fu, and Silver island, Se Yun Kau creek to Silver island. 3*s*.
3565 m = 0·48 New Zealand, north island:—Bream head to Tepaki point (Mercury bay), including Hauraki gulf. 3*s*.
2527 m = 0·25 New Zealand, sheet iii.:—Mayor island to Poverty bay. 3*s*.
3576 m = {7·5 / 6·0} Fiji islands:—Namuka harbour, Nai Toni Toni and Veivatuloa anchorages. 3*s*.

New Plans and Plans added.

2114 m = 5·0 Baltic entrance:—the Kattegat. Plan added:—Anholt harbour. 3*s*.
1596 m = 5·99 Harbours and anchorages on the coast of Italy. Plan added:—Port Sorrento. 3*s*.
1221 m = 2·50 Labrador:—Harbours and anchorages in Hudson bay and strait. Plan added:—Hebron bay. 2*s*. 6*d*.
1282 m = 3·65 Chile, sheet vii.:—Lora point to Maitencillo. Plan added:—Port Lapallar. 2*s*.
1300 m = 2·43 Plans on the coast of Chile. New Plan:—Port Papudo. 2*s*.
2732 m = {0·91 / 1·45} Plans of anchorages in Bali, Lombok, etc. Plans added:—Grajagan bay, Pangpang bay. 1*s*.
2873 m = 5·7 Anchorages in the Solomon Islands. Plan added:—Ngora fu harbour. 2*s*.

(*J. D. Potter, Agent.*)

Charts Cancelled.

No.		Cancelled by	No.
1410	Wales, west coast. St. Goven's head to New Quay. Plan of Fishguard bay on this sheet.	New chart. Fishguard bay	3580
2842*a*	Baltic sea. Plans of Faero and Aarö sounds on this sheet.	New chart. Trælle nes to Aarö sund	3465
2202*b*	South Atlantic ocean, western portion. Plans of South Georgia and Moltke harbours on this sheet.	New chart. South Georgia. Plans. Royal bay, King Edward cove, Moltke harbour, sketch of Cumberland bay	3579
1277	Chile. Point Grande to Point San Francisco. Plan of Antofagasta on this sheet.	New chart. Plans on the coast of Chile, Antofagasta, Hornos cove, Coloso cove	3573
2346	Plans on the coast of Chile. Plan of Coloso cove on this sheet.		
591	United States, west coast. San Francisco harbour.	New chart (preliminary). San Francisco harbour	591
27	Persian gulf. Abú shahr, or Bushire.	New chart. Abu shahr (Bushire)	27
3283	Plans in the Philippine islands. Port Salomague and approach.	New chart. Plans in the Philippine islands, Salomague harbour and Lapog bay, Port Kurrimao and Gan bay	3283
2376	Harbours in Formosa. Plan of Port Kok Si on this sheet.	— — — —	
1288	China. Yang tse Kiang, Chin Kiang fu, and Silver island.	New chart. Chin Kiang fu and Silver island, Se Yun Kau creek to Silver island	1288
2527	New Zealand, sheet iii. Mayor island to Poverty bay.	New chart. Mayor island to Poverty bay	2527

(*J. D. Potter, Agent.*)

Charts that have received Important Corrections.

No. 871, England, south coast:—Tamar river. 2364, Germany, north coast:—Lübeck bay and Fehmarn belt. 2789*h*, River St. Lawrence (Sheet 21):—Cole shoal

light to Rockport. 2806, United States, east coast:—Charleston harbour. 554, South America:—Magellan strait. 1289, Chile (Sheet 4):—Guaitecas islands to Cape St. Antonio. 1325, Chile:—Gulf of Peñas to the Guaitecas islands. 3447, British Columbia:—Moresby passage with its approaches. 1922, British Columbia:—Fraser river and Burrard inlet. 1501, Alaska, Aleutian islands:—Seguam island to Attu island. 655, India, west coast:—Port of Bombay. 2455, Andaman islands:—Stewart sound. 975, Philippine islands:—Port Kavite. 1578, Japan, Simonoseki strait. 2460, Pacific ocean:—Kamchatka to Kadiak island including Bering sea and strait.

(*J. D. Potter, Agent.*)

Arctic Ocean. **Breitfuss and Smirnov.**

Bathymetrical Chart of the Murman Coast from Surveys by the Murman Scientific Expedition, 1905. By L. Breitfuss and A. Smirnov. Scale 1:1,077,120 or 1 inch to 17 stat. miles. St. Petersburg, 1906. *Presented by Dr. L. Breitfuss.*

Gives soundings in sashines (one being equal to seven English feet), in addition to the general indication of depths by tints of blue. The chart is an additional one to those noticed in the *Geographical Journal* for June last, and furnishes further proof of the useful oceanographical work accomplished by the Murman Scientific Expedition.

Danish Charts. **K. Danske Søkort-Arkiv.**

Danish Hydrographic Charts. Nos.: 209, Færøerne med omgivende Flak; 210, Sundet; 211, Kattegat; 212, Islands Nordkyst, Skagafjørdr-Langanes. Copenhagen: Kongelige Danske Søkort-Arkiv, 1905-06. *Presented by the Danish Admiralty.*

Indian Ocean. **Meteorological Office.**

Meteorological Chart of the Indian Ocean north of 15° S. lat., and Red Sea for September, 1906. London: Meteorological Office, 1906. *Price 6d. Presented by the Meteorological Office.*

North Atlantic and Mediterranean. **Meteorological Office.**

Meteorological Chart of the North Atlantic and Mediterranean for September, 1906. London: Meteorological Office, 1906. *Price 6d. Presented by the Meteorological Office.*

North Atlantic. **U.S. Hydrographic Office.**

Pilot Chart of the North Atlantic Ocean for August, 1906. Washington: U.S. Hydrographic Office, 1906. *Presented by the U.S. Hydrographic Office.*

North Pacific. **U.S. Hydrographic Office.**

Pilot Chart of the North Pacific Ocean for September, 1906. Washington: U.S. Hydrographic Office, 1906. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

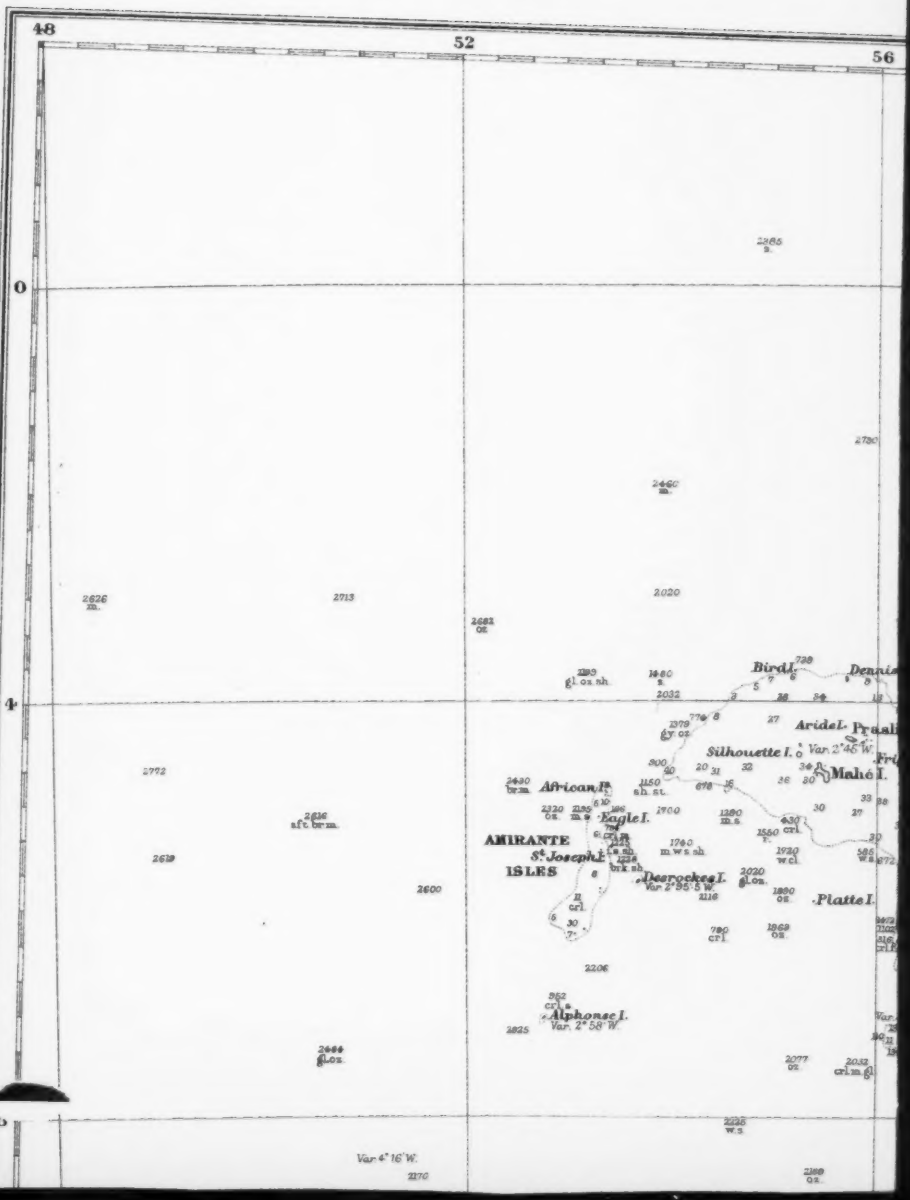
Asiatic Turkey and Persia. **Hopkins.**

Twenty photographs of Asiatic Turkey and Persia, taken by Captain L. E. Hopkins, R.E. *Presented by Captain L. E. Hopkins, R.E.*

An excellent series of platinotypes, measuring $7\frac{1}{4} \times 10\frac{3}{4}$ inches. The titles are as follows:—

(1) Raft leaving Diarbekr; (2) Entrance to Tigris gorge; (3) A rapid; (4–6) Views of the Tigris gorge near the Bohtau Su; (7) Mosul, river front; (8) Plain behind Ahwaz; (9) Foothills of Bakhtiara mountains; (10) Street in Behbahan; (11) Dagumbazan; (12) Near Lishter; (13) Gunjgun; (14) Meadows near Basht; (15) Castle of Basht; (16) Mahmasceni chief and followers; (17) Ruins of Sassanian bridge at Falyan; (18) Pul-i-Murt; (19) Shah-seni; (20) Deh-i-nau at head of Pul-i-Murt valley.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.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Eagle I.
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St. Joseph I.
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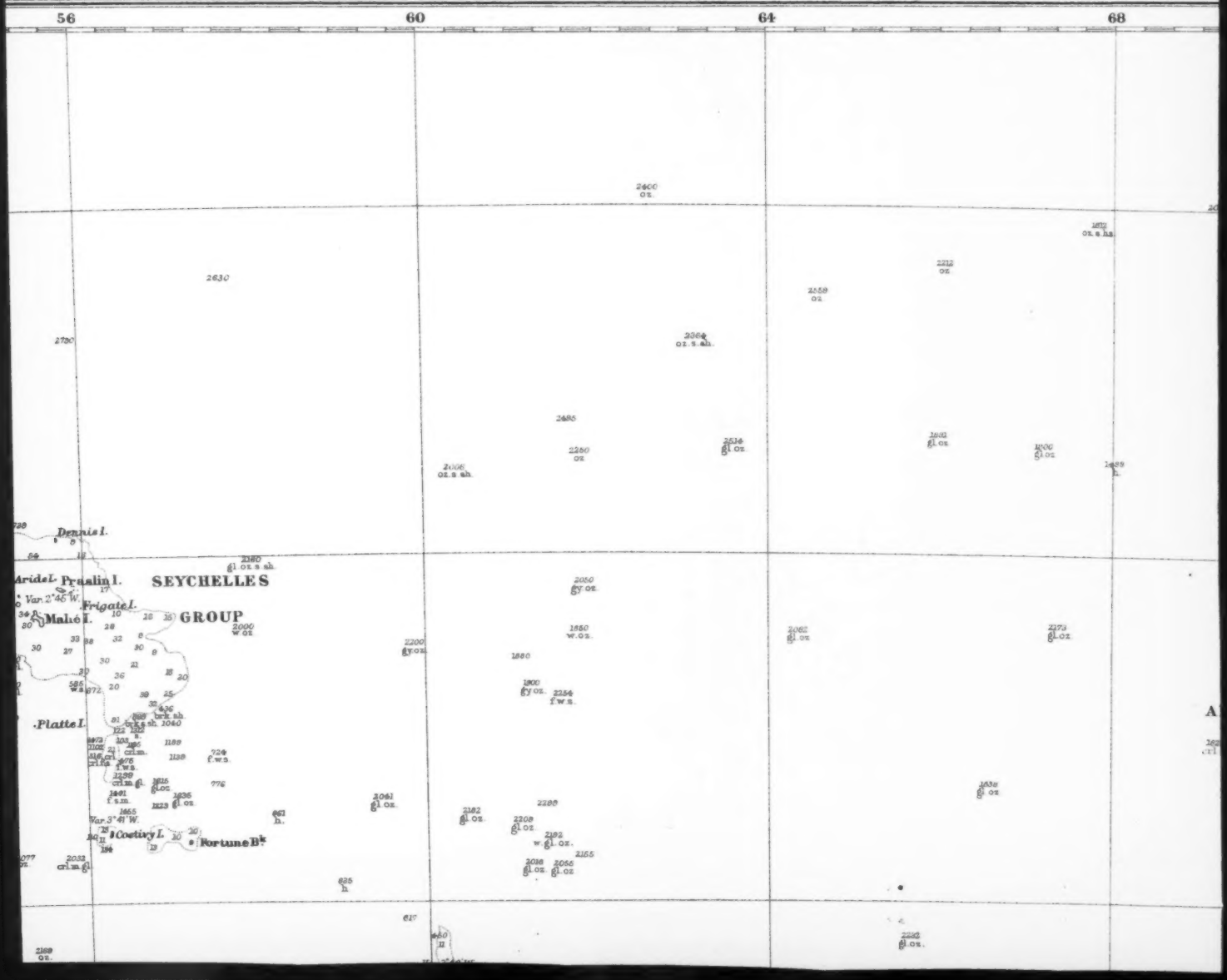
Platte I.
Alphonse I.
Var. 2° 58' W.
Var. 4° 16' W.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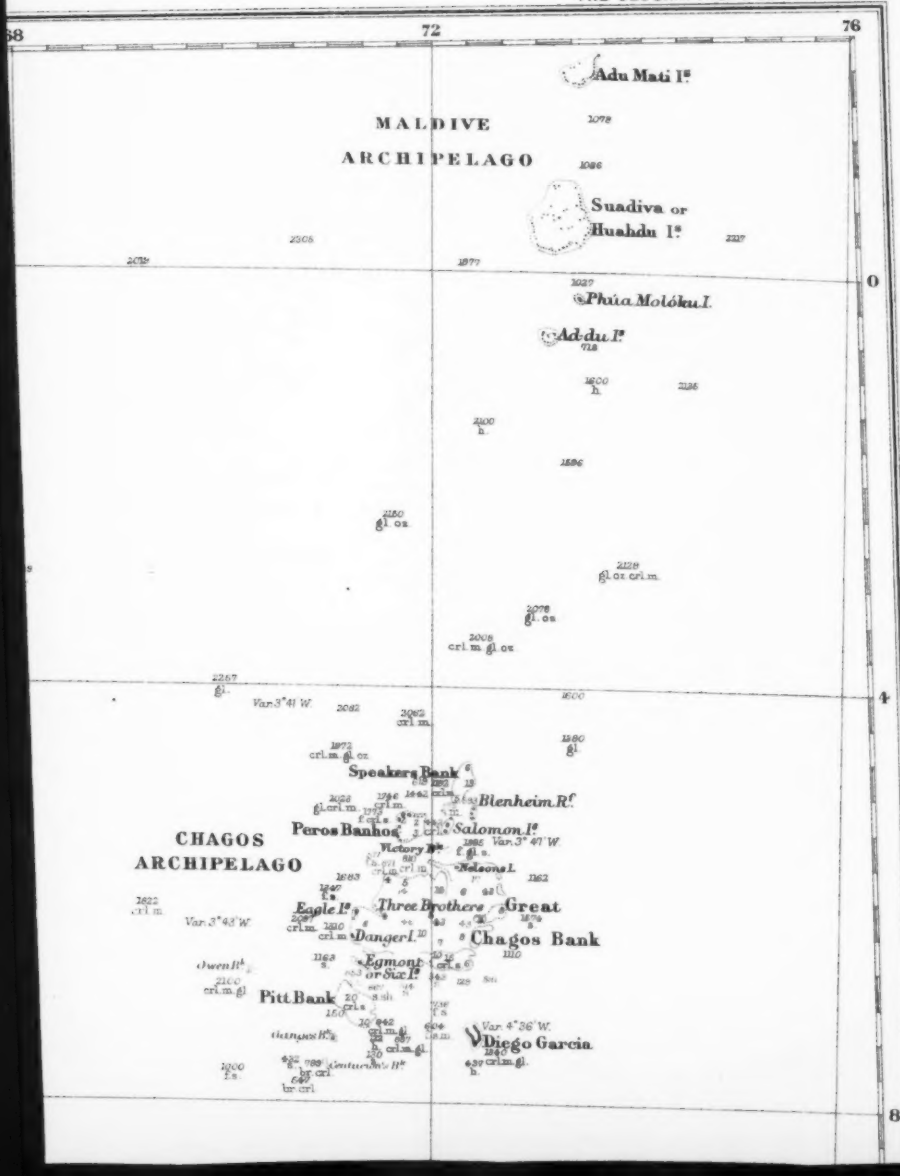
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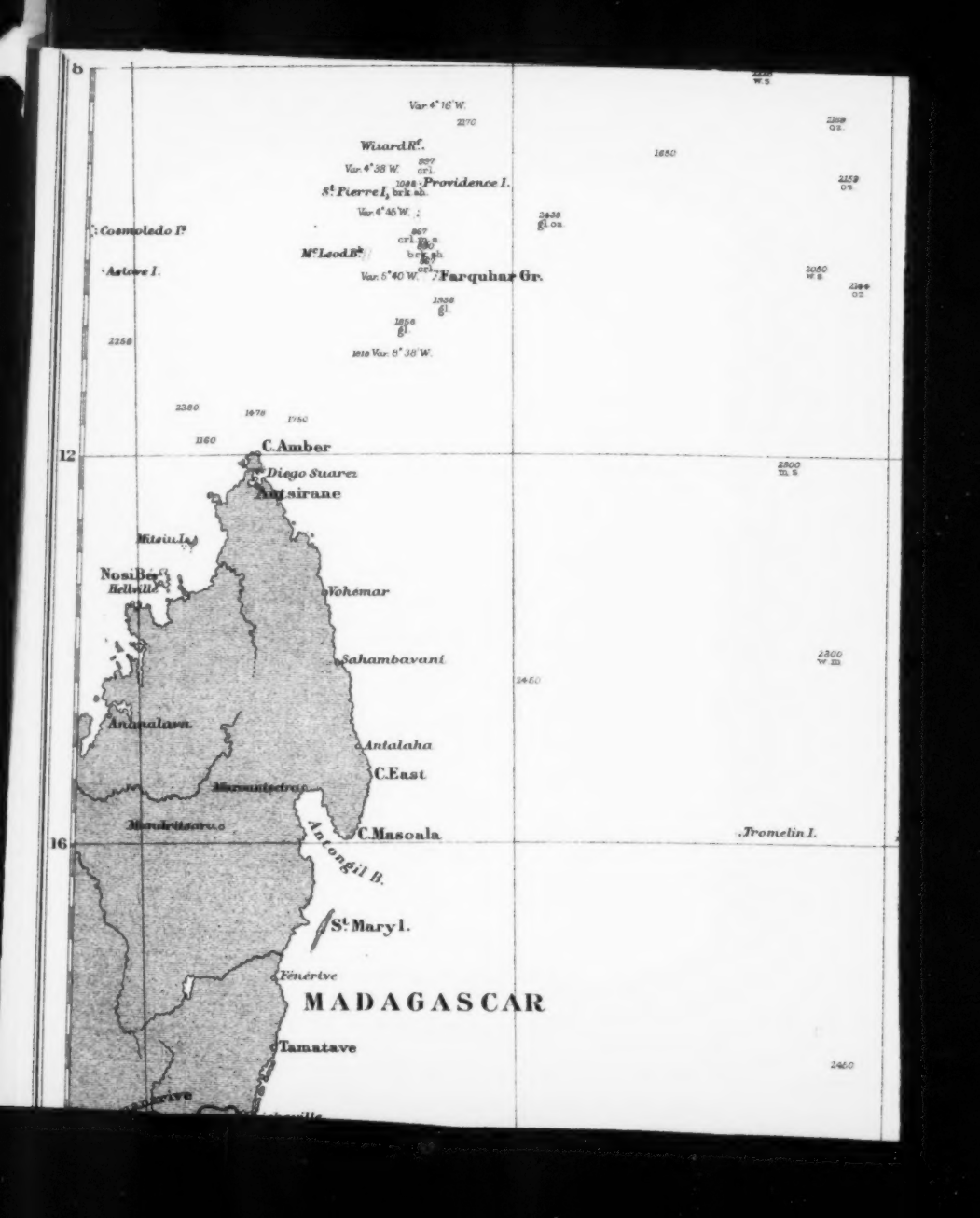
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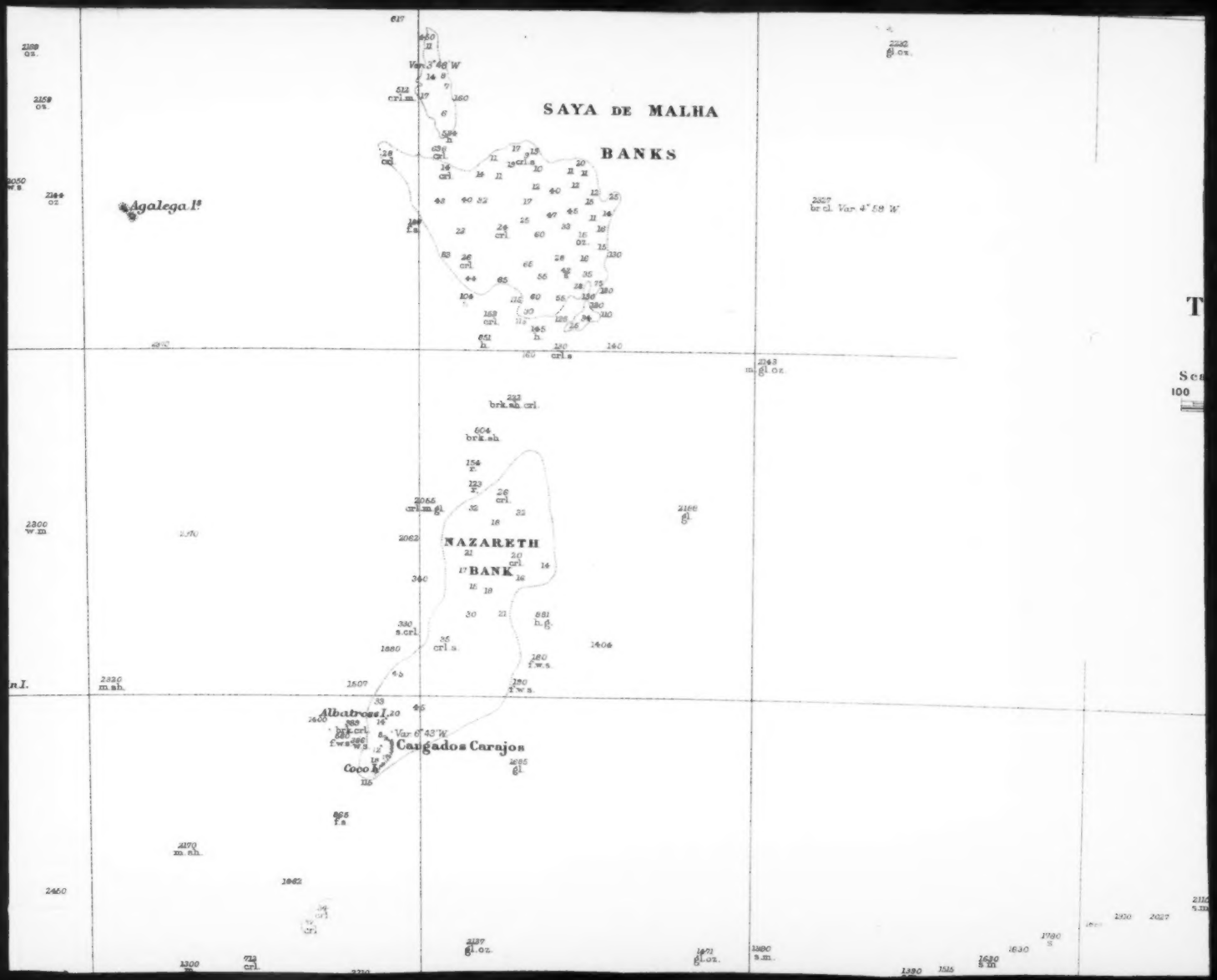
SAYA DE MALHA
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Cargados Carajos
Coco I.
Var 3° 46' W
Var 4° 58' W

THE INDIAN OCEAN

to illustrate a paper by

J. STANLEY GARDINER, M.A.

Scale, 1:7,000,000 or 1 inch = 110·47 Stat. Miles.

100 50 0 100 200

Reference.

The soundings are expressed in Fathoms
The 100 fathom line is shown thus ——
The following abbreviations show the quality of bottom:—
br. *brown*, brk. *broken*, cl. *clay*, crl. *coral*, f. *fine*, gl. *globigerina*, h *hard*, m. *mud*, oz. *ooze*, r. *rock*, s. *sand*, sft. *soft*, sh. *shells*, w *white*.

8

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2437 2305

2110 s.sh. 2380

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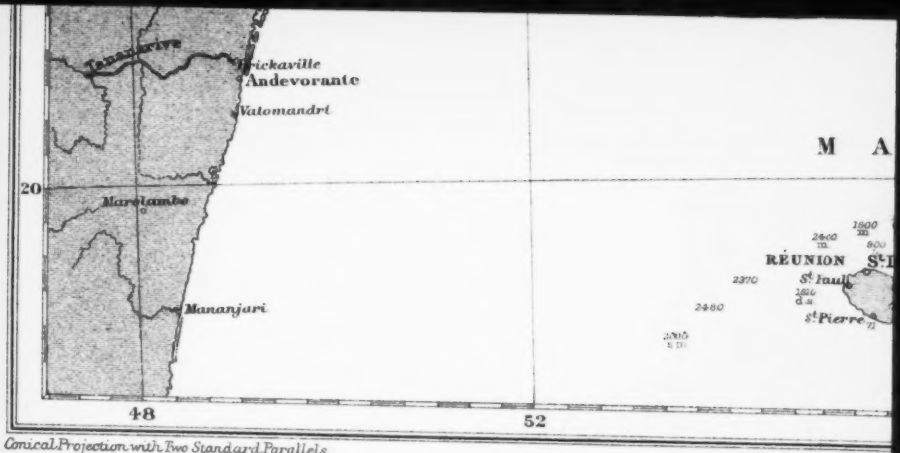
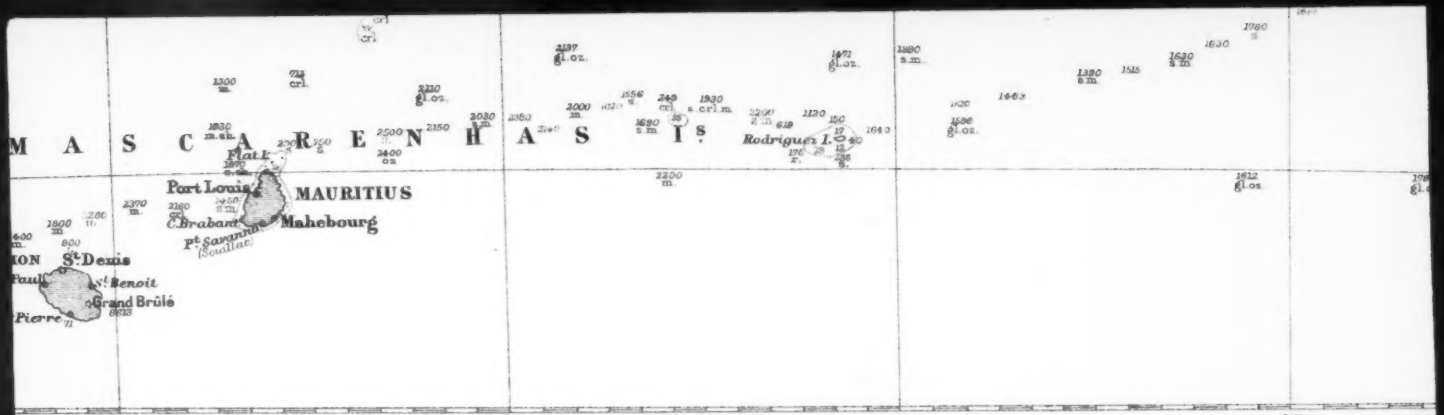


Conical Projection with Two Standard Parallels



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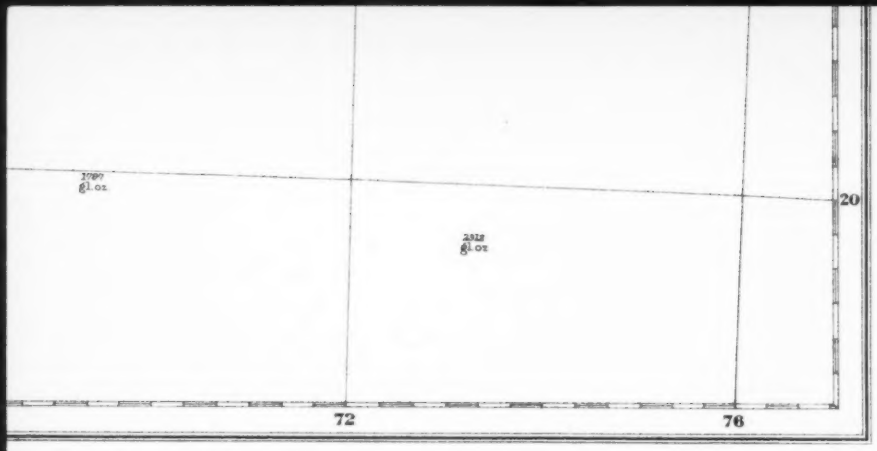
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